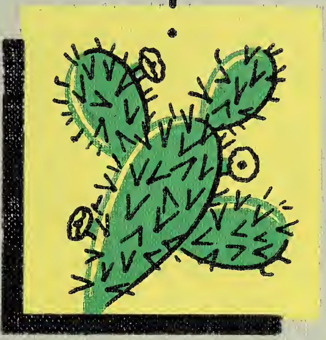
EXPLORING SCIENCE

Four

THURBER



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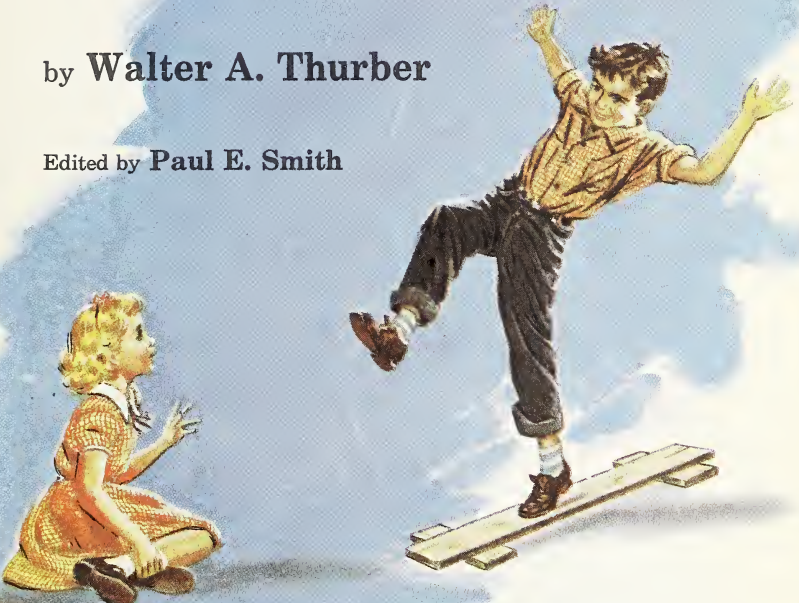
EXPLORING SCIENCE *Four*

by **Walter A. Thurber**

Edited by **Paul E. Smith**



THE MACMILLAN COMPANY
OF CANADA LIMITED
TORONTO

EXPLORING SCIENCE SERIES

One · Two · Three · Four · Five · Six

READING
CONSULTANT

Linda C. Smith

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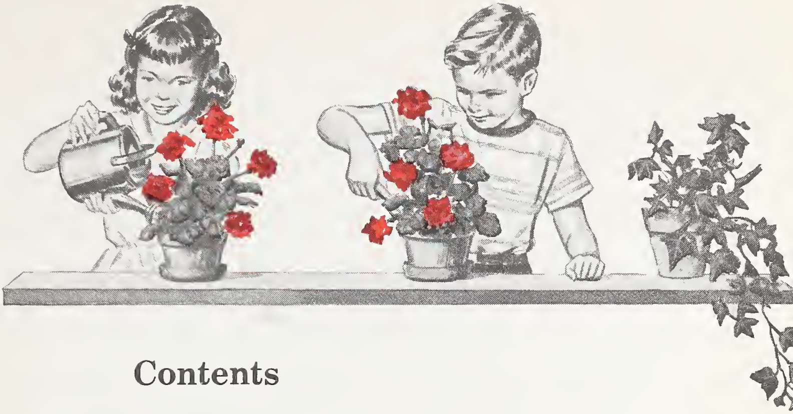

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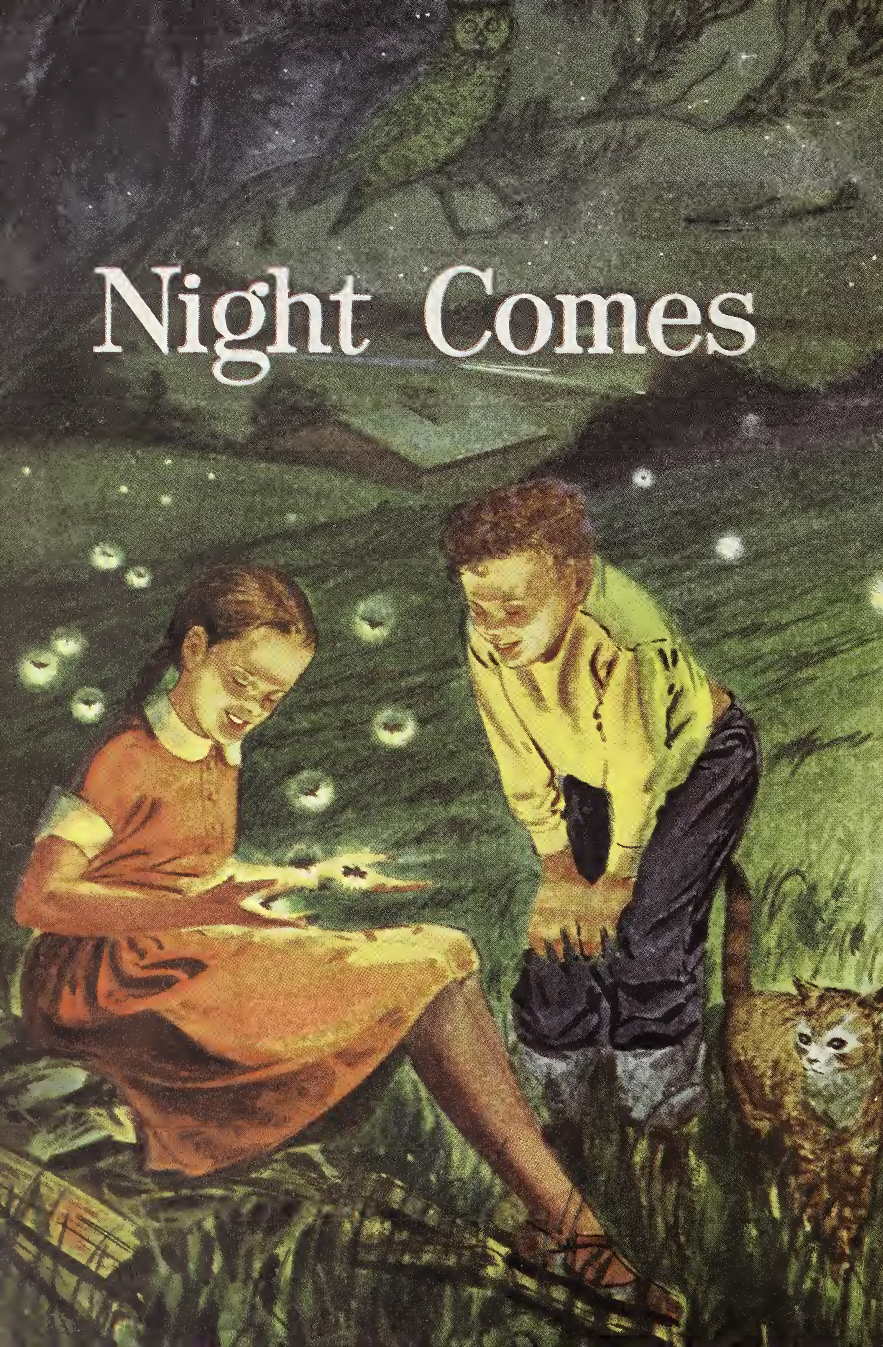
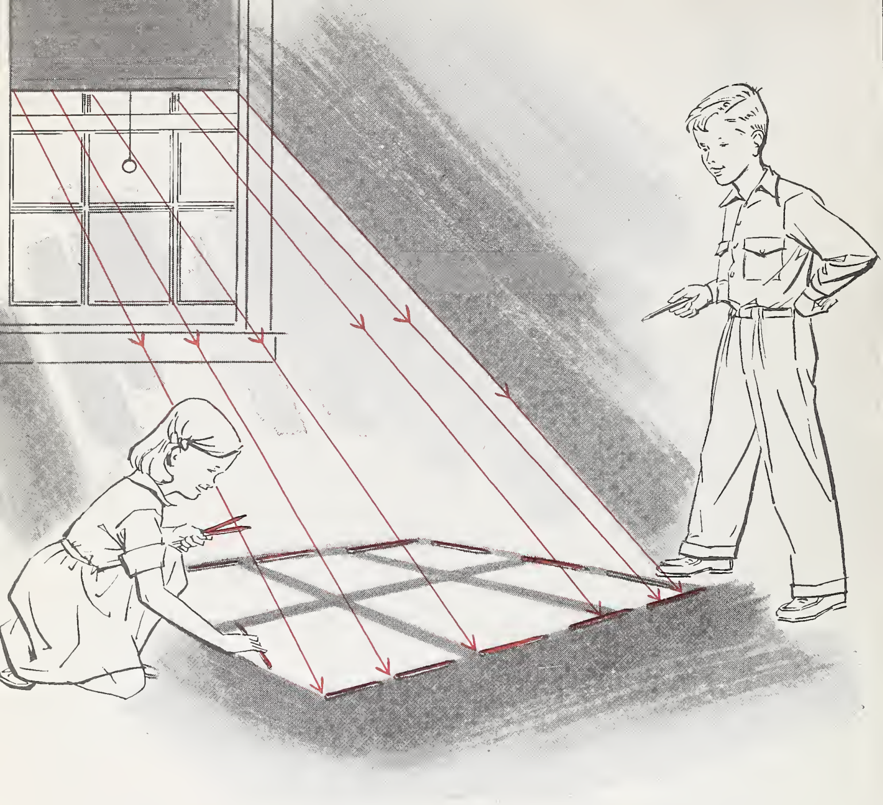
Night Comes



When Night Comes

There are many things for you to study when night comes. You can see things in the sky that you cannot see in the daytime. You can see animals that hide during the day and move about at night. Some plants close up their flowers and fold their leaves at night.

What things have you seen outdoors at night? What lights have you seen? What games do you play outdoors at night?



The Sun Moves

During the day you can see that the sun appears to move across the sky. Indoors you can put pencils around the edges of a spot of sunlight on the floor. In a few minutes you will see that the spot of sunlight has moved.

Outdoors you can mark the end of a shadow. In a few minutes you will see that the shadow has moved. In late afternoon the shadows move very fast. Do they grow longer or shorter in the afternoon?

Evening Shadows

Look at the sun going down some evening. You will see that it needs only a few minutes to move out of sight.

Watch the shadows of trees, buildings, and people as the sun goes down. The shadows grow longer and longer.

Hills make shadows too. Watch the shadows of hills grow longer.

At last the shadows of the hills will reach you. Then you will not see the sun and things will become darker.

You may see the sun shining on tall trees and buildings for a short time. You may see the sun shining on hills behind you a little longer. And you may see the sun shining on clouds after everything else is in shadow.

Nightfall

For a short time after the sun goes down, some of its light is reflected to us from clouds and from dust in the air. We call this kind of light "twilight." Find out how long twilight lasts some evening.

When everything is in shadow, night has come. What light do we have then? Is there enough light to see things outdoors? Is there enough light to tell what colours things have?

Usually we feel cooler when the evening shadows come. The sun gave us heat all day, but we begin to lose some of this heat as soon as we are in shadow.

Remember to look at a thermometer some clear afternoon, and then look at it again in the evening to see what happens.

On clear nights we often find little drops of water on spider webs and on plants. What do we usually call these drops of water?

Some of these drops of water may come from the leaves of the plants. But most of the drops condense from water vapour in the air. What does temperature have to do with these drops of water?

If the night were very cold, might we find frost instead of drops of water?

There are many animals that look for food at night. Owls hunt mice and other small animals. Bats catch insects flying through the air. Moths drink the sweet juice in flowers. Skunks hunt for mice and insects, and they eat berries and other small fruits. Rabbits do most of their feeding after dark.

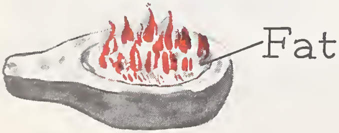
What are some other animals that feed at night? What do they eat?

Have you heard owls call at night? Have you heard crickets chirp? What other animals have you heard at night?

Light for Nighttime

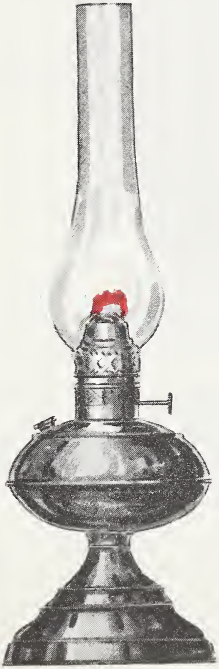
The first light man ever made must have been a campfire. Then he may have learned to carry torches of burning wood.

We have found old stone lamps in caves. We think people burned fat in these lamps so they could have light at night.



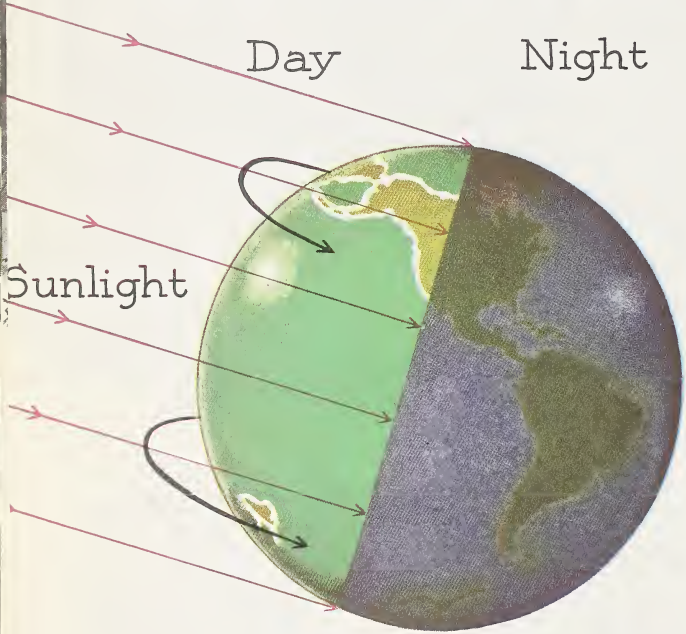
People invented the candle long ago. We do not know how it was discovered. Read about the ways candles are made. Perhaps you can make some too. Tell about the ways candles are used today.

What other kinds of light has man used? What kinds do we use today? Read about the ways these different kinds of light were discovered.



What Makes Day and Night?

People have always wondered where the sun goes after it goes down in the west. And they have wondered how it went back to the east to rise there in the morning.

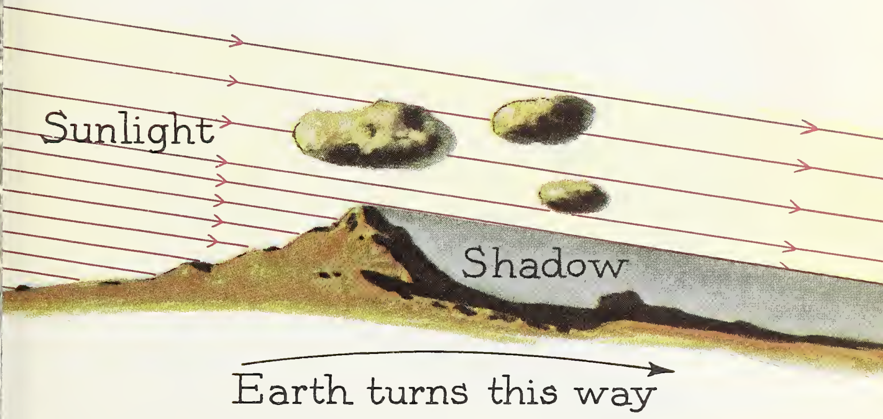


We believe today that the earth is shaped like a ball. The side that is toward the sun is in daylight. The side that is in the shadow has darkness.

We believe also that the earth keeps turning around. As the earth turns, we are in the sunlight part of the time and in the shadow part of the time. We believe that is the reason why we have day, then night, and then day again.

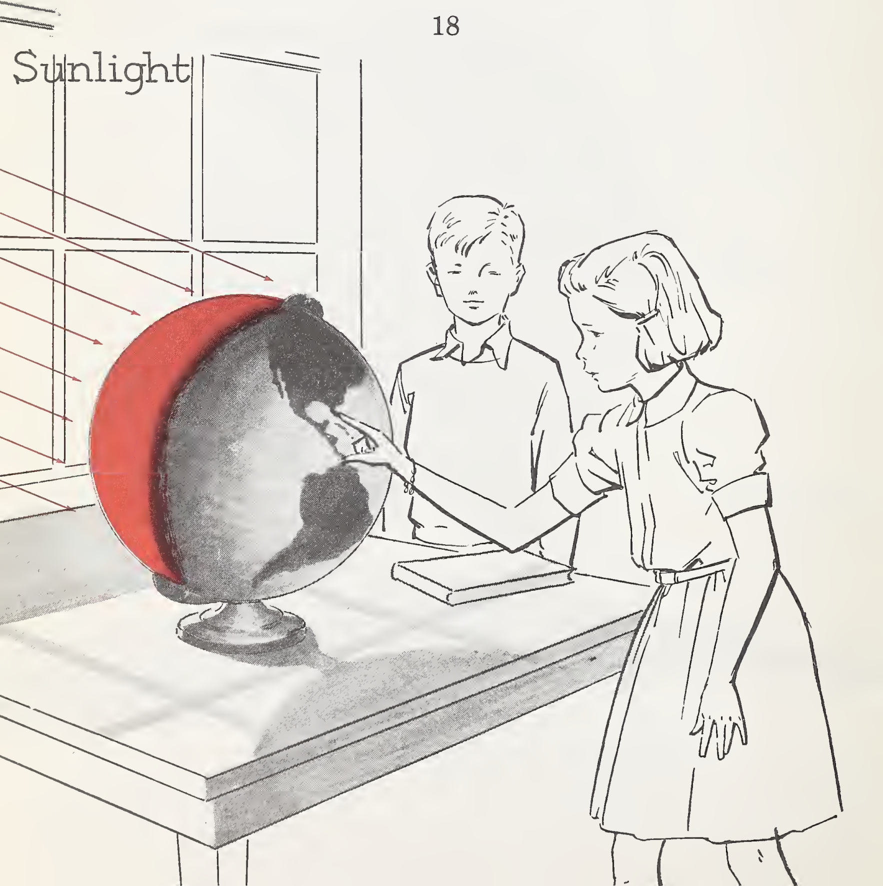
The picture below may help you understand what happens when the sun goes down. Can you see why the shadows of the hills grow longer? Can you see why there is sunlight on the clouds after the earth beneath is in shadow?

Can you make a drawing to show what happens at sunrise?



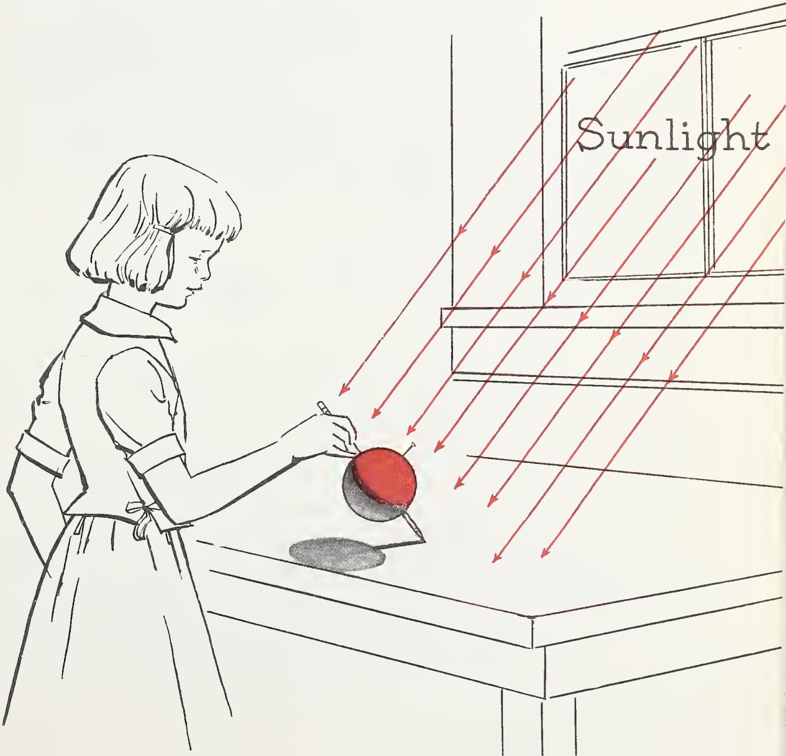
Set a globe in a sunny window. Find the place where you live. Watch this place as you turn the globe from right to left.

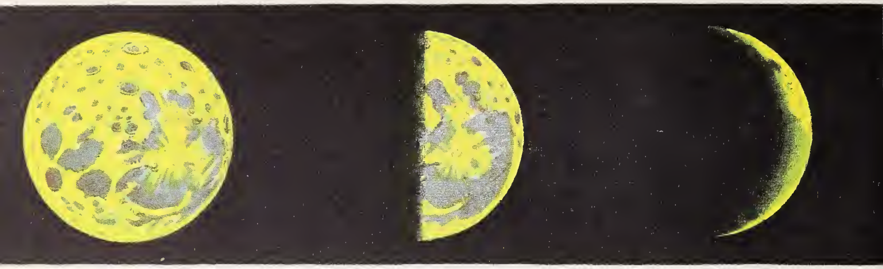
When the place where you live moves into the shadow it is night there. When it moves into the sun it is daytime. Turn the globe until the sun is over the place where you live, as it would be at noon.



Push a sharp pencil through an orange. Stick a pin in one side of the orange. Take the orange to a sunny window. Turn the orange around. Watch the shadow of the pin.

What is the shadow like when the sun is overhead? What happens to the shadow when the orange is turned farther? Do these shadows change like the shadows you see outdoors?





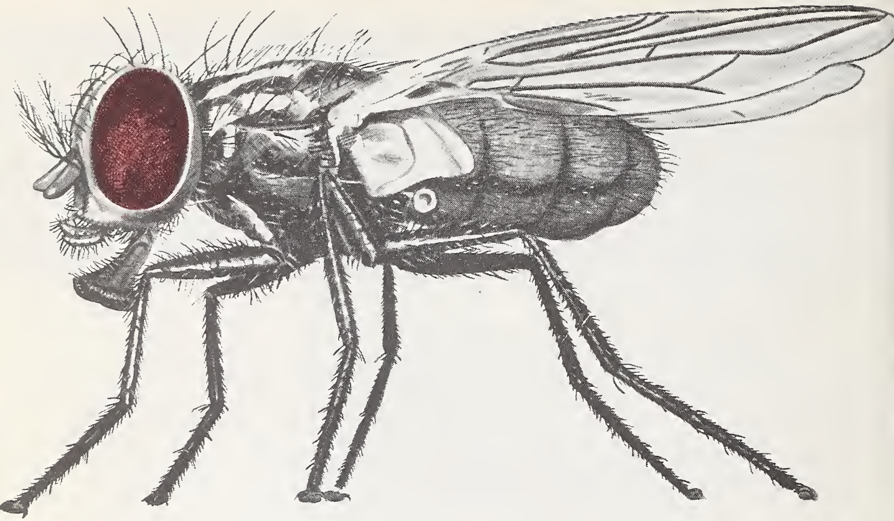
The moon has day and night, too. In the picture at the left, the side of the moon toward us is in the sunlight. It is night on the side away from us.

Look at the other two pictures of the moon. Where is it day and where is it night in each one?

---

1. Why do shadows grow longer in the afternoon?
2. What is twilight?
3. What do we think is the cause of day and night?
4. During nighttime here, what part of the world has daytime?
5. What things happen as night comes?
6. What animals hunt food at night?
7. What are some different kinds of light we use at night?

Insects That Carry Disease

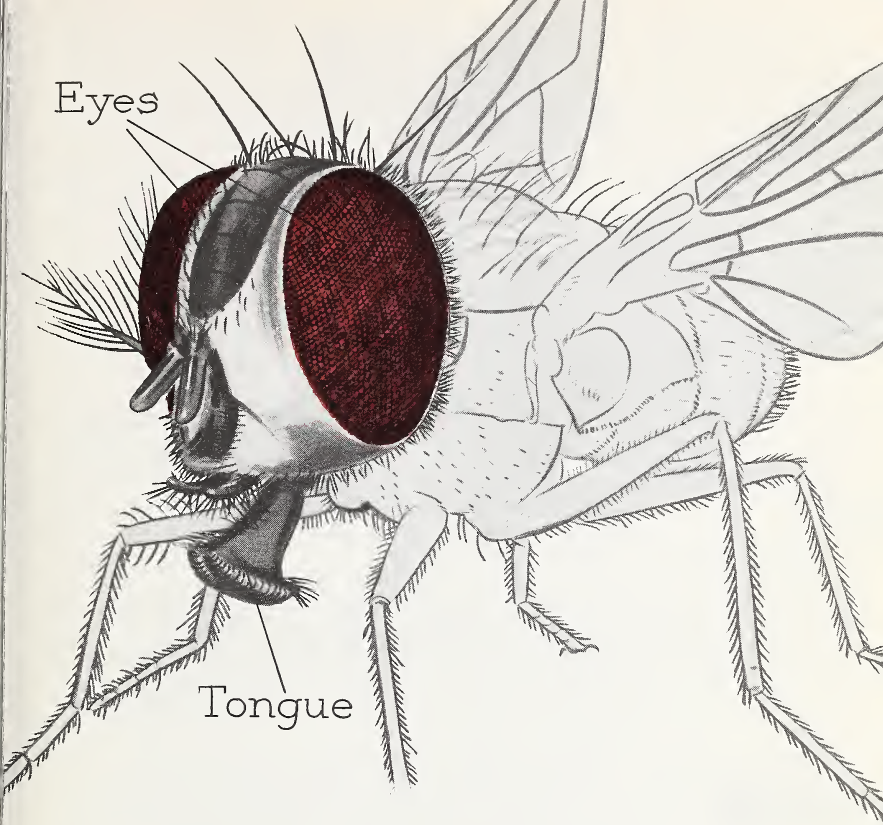


Houseflies Carry Disease

The most dangerous of all insects are the houseflies. Houseflies live in dirty places and can carry some of the dirt to your food.

Many kinds of **bacteria** live in this dirt. Bacteria are tiny living things that cannot be seen without a microscope. Some of the bacteria in the dirt can give you diseases.

Look at a fly with a hand lens. You can see that the fly is covered with many tiny hairs. Bits of dirt stick to these hairs.



A housefly wets its food with its tongue as it eats. Sometimes the fly has been eating food that is filled with disease bacteria. Then the fly may leave the disease bacteria on our food.

Watch a housefly eating. Watch it use its tongue as it wets its food.

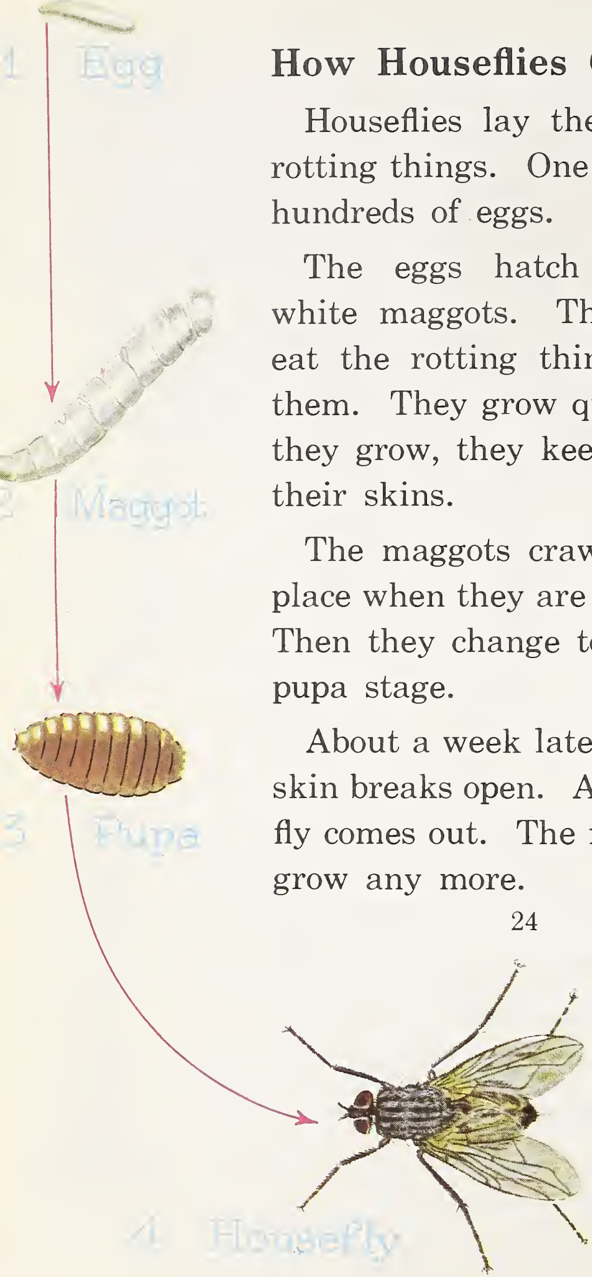
How Houseflies Grow Up

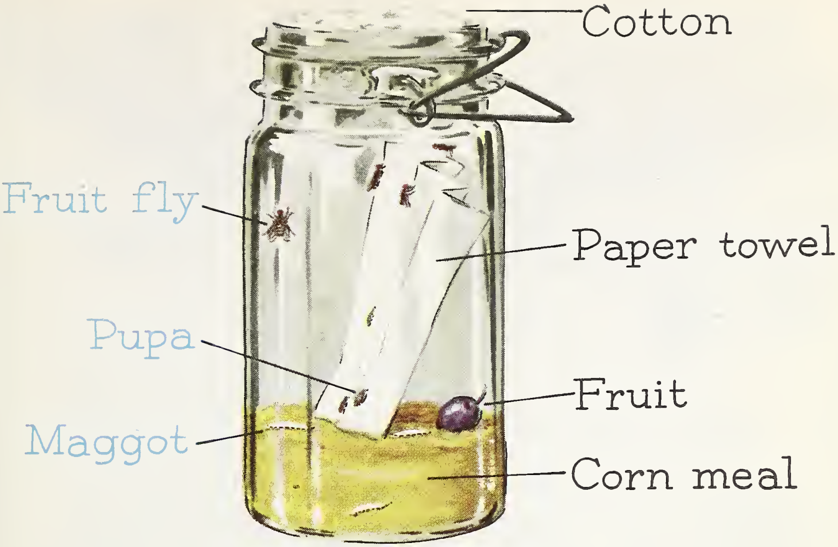
Houseflies lay their eggs in rotting things. One fly can lay hundreds of eggs.

The eggs hatch into tiny white maggots. The maggots eat the rotting things around them. They grow quickly. As they grow, they keep shedding their skins.

The maggots crawl to a dry place when they are full grown. Then they change to the quiet pupa stage.

About a week later, the pupa skin breaks open. A full-grown fly comes out. The fly does not grow any more.

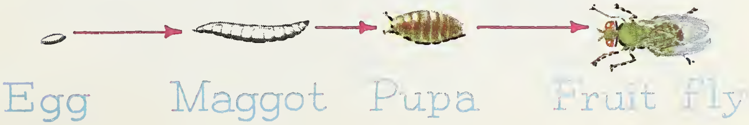




There are many other kinds of flies. One kind that lives in rotting fruit is called the "fruit fly."

You can raise fruit flies easily. Boil some corn meal for five minutes and pour it into a clean jar. Drop in a grape or a piece of banana. Fold a piece of paper towel and put that in, too.

Leave the jar near some spoiling fruit until six or eight flies are inside. Then put cotton in the top. Leave the jar in a warm room and watch it.

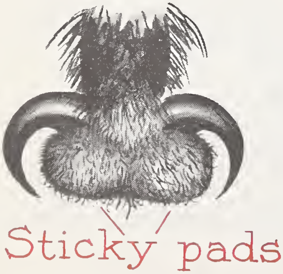


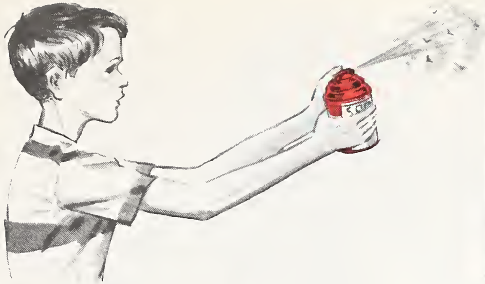
How Flies Walk on Walls

Flies have two little claws at the end of each foot. These claws help the fly climb up rough things.

Between the claws are two little pads covered with sticky hairs. These sticky pads help the fly climb on smooth things. A fly can climb a window pane easily, and it can even walk upside down on the ceiling. The sticky pads hold the fly to the ceiling. Watch a fly walk on a window pane or on the ceiling.

How do you think the sticky pads help the fly carry disease bacteria?



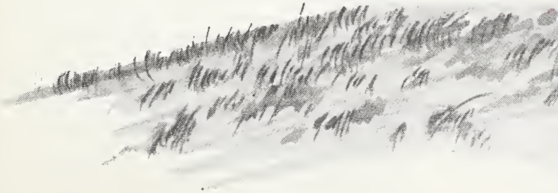


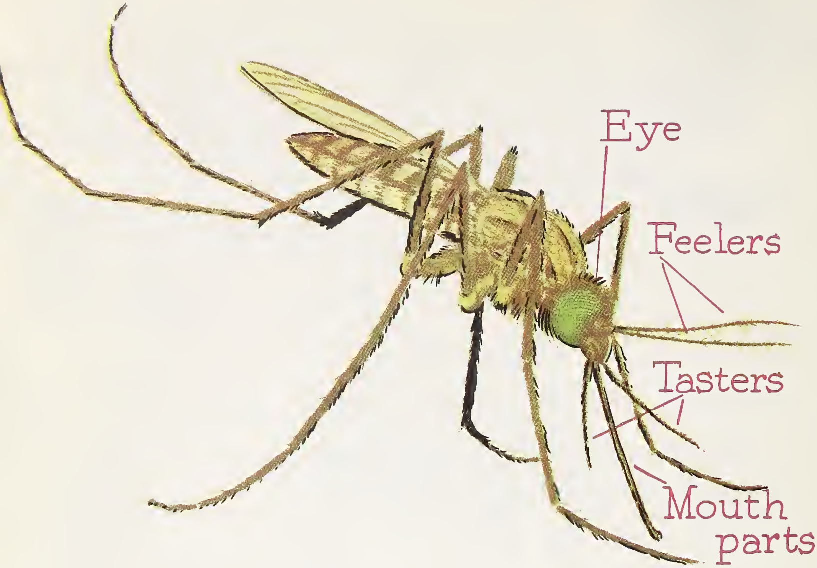
Protecting Ourselves from Flies

We should do everything we can to keep flies from our homes and our food.

We should clean up the things that make flies want to come to our homes. We should keep garbage in covered pails. What else can we do?

What can we do to the flies that do get into our homes?



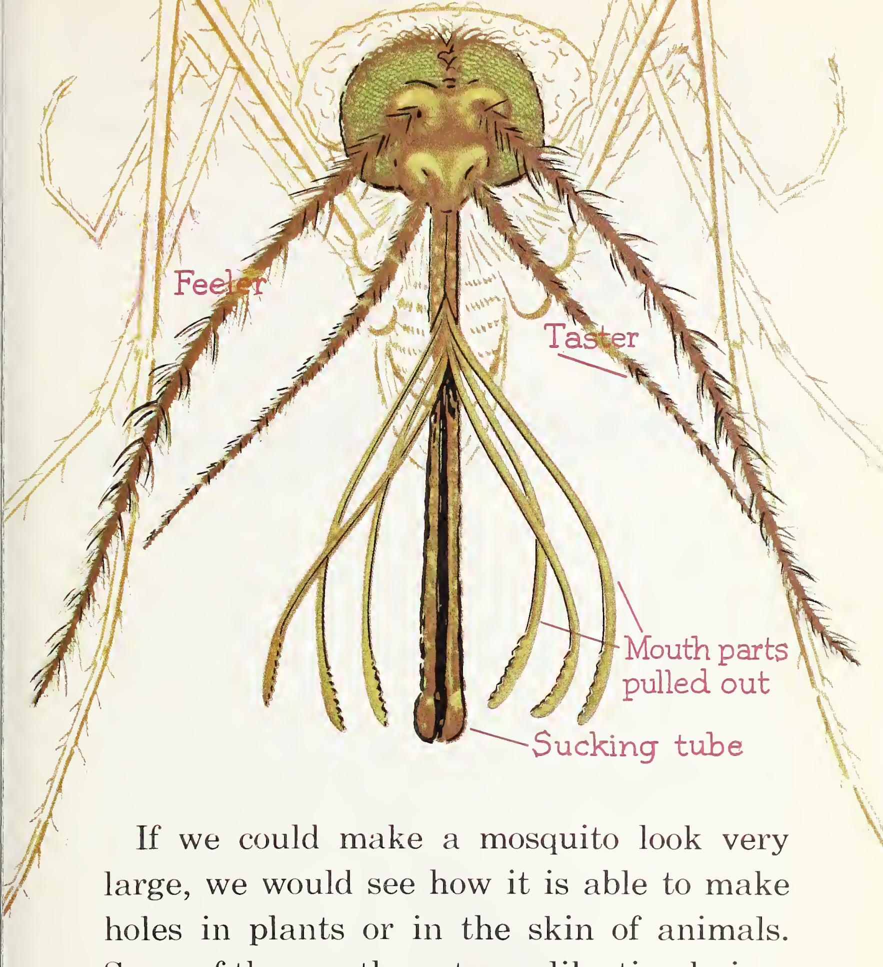


How Mosquitoes Eat

Mosquitoes have long, sharp mouth parts. They can make holes in plants and suck the juices.

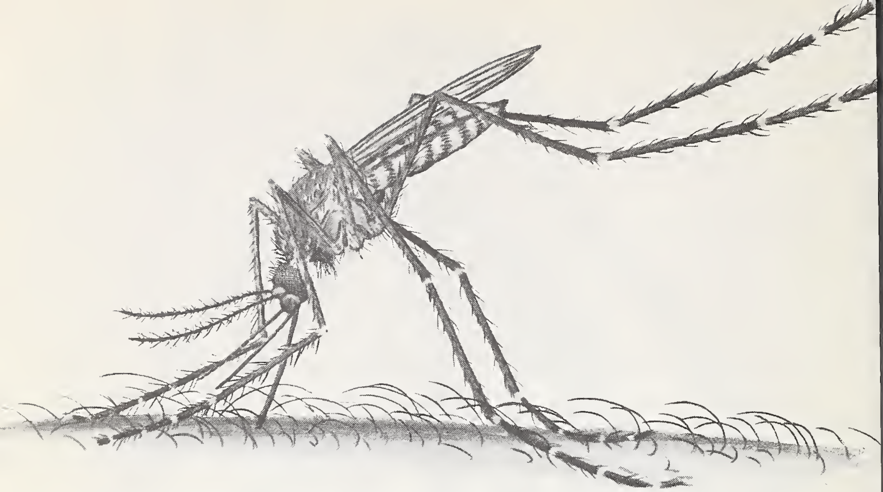
Female mosquitoes also make holes in the skin of animals and suck blood. Female mosquitoes are the ones that lay the eggs.

Male mosquitoes do not suck blood.



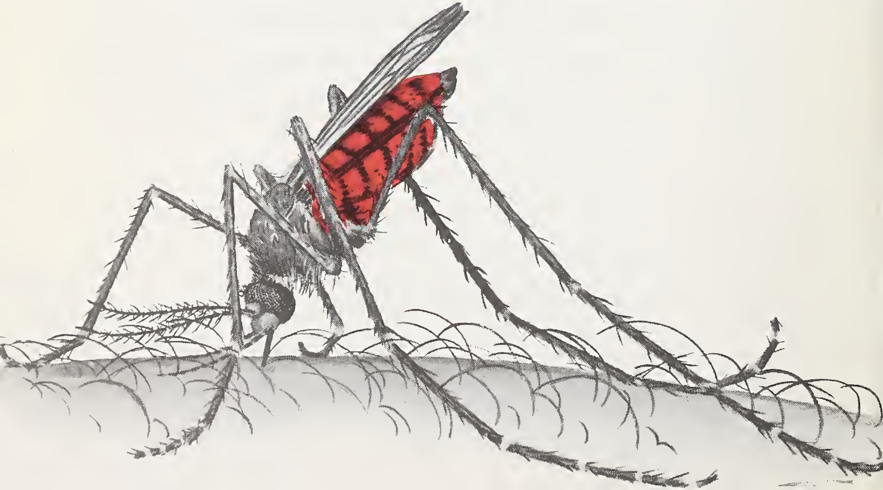
If we could make a mosquito look very large, we would see how it is able to make holes in plants or in the skin of animals. Some of the mouth parts are like tiny knives and saws.

There is a tube around the sharp parts. The mosquito drinks through the tube much as you drink through a soda straw.



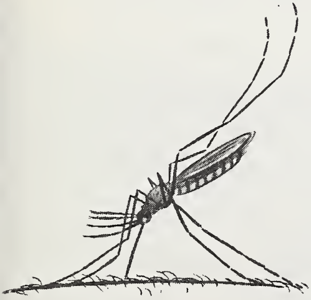
In the picture at the top of the page, we see a female mosquito getting ready to eat. She is beginning to make a hole in someone's skin.

In the picture at the bottom, the mosquito is sucking blood. She is nearly full.

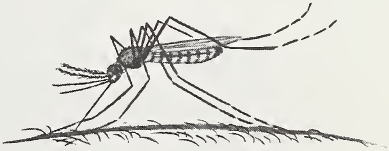


How Mosquitoes Carry Disease

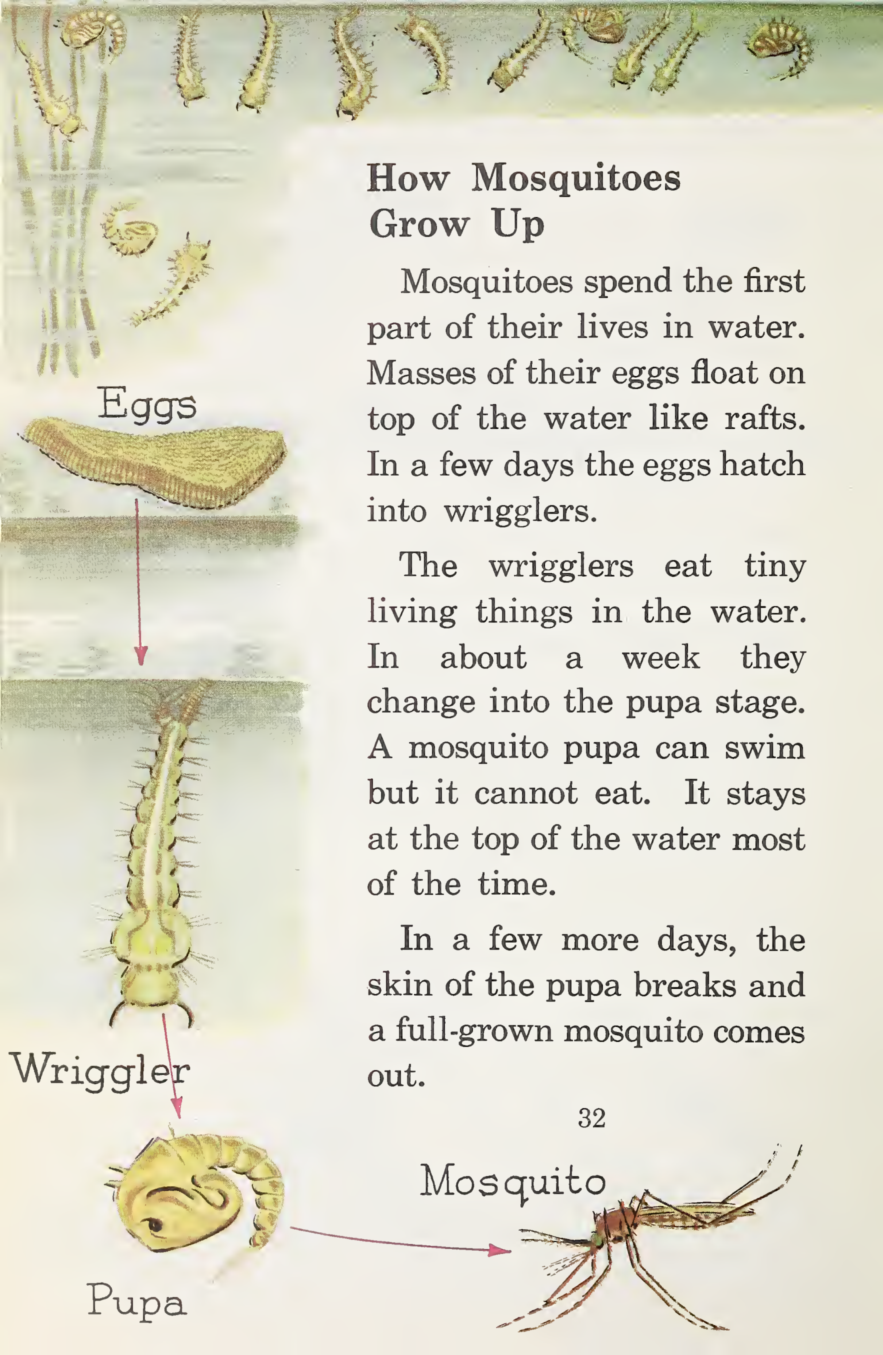
Some kinds of mosquitoes carry diseases. They may take blood from sick people. Then they may bite people who are well and give them the same disease.



This mosquito
can carry disease.



This mosquito
does not carry disease.



How Mosquitoes Grow Up

Mosquitoes spend the first part of their lives in water. Masses of their eggs float on top of the water like rafts. In a few days the eggs hatch into wrigglers.

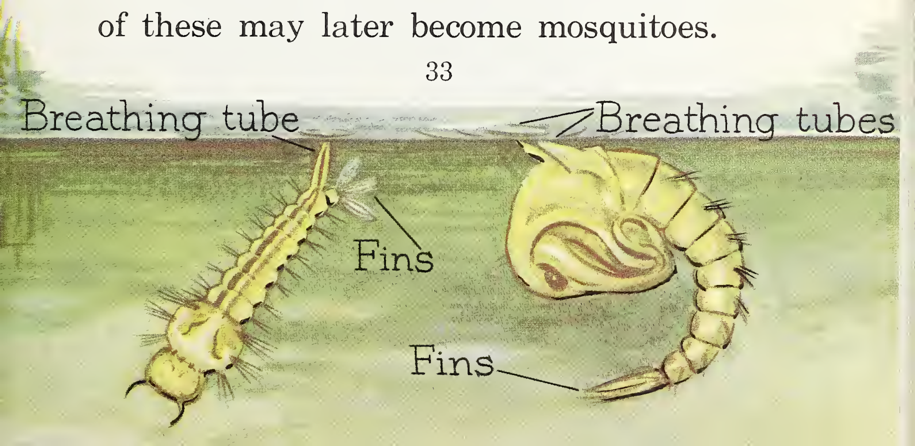
The wrigglers eat tiny living things in the water. In about a week they change into the pupa stage. A mosquito pupa can swim but it cannot eat. It stays at the top of the water most of the time.

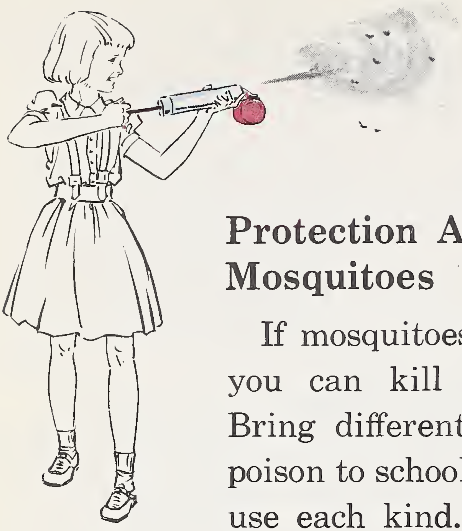
In a few more days, the skin of the pupa breaks and a full-grown mosquito comes out.

Find some mosquito wrigglers and put them in a glass of water. Watch them and you can see why they are called "wrigglers."

Watch one wriggler. You will see that it comes to the top often. It comes to the top for air.

Put some wrigglers in a glass jar and tie a piece of cloth over the top. Use water from the pool where you found the wrigglers. Watch the wrigglers for a few days. Some may change into the pupa stage and some of these may later become mosquitoes.





Protection Against Mosquitoes

If mosquitoes get in your home, you can kill them with poison. Bring different kinds of mosquito poison to school and find out how to use each kind.

How can you keep mosquitoes from getting into your home?

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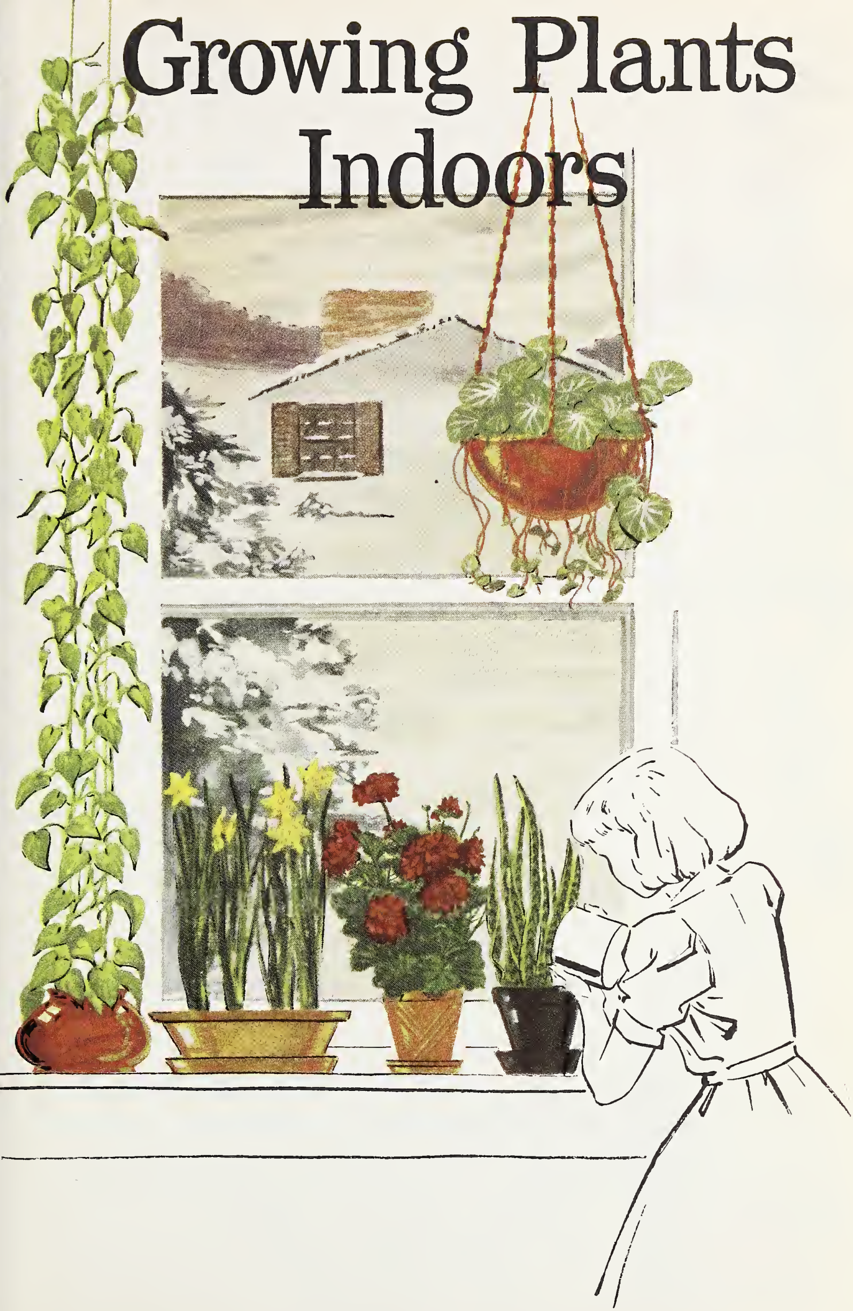
1. Tell the life story of a housefly and of a mosquito.
2. What do houseflies and mosquitoes eat?
3. How many legs and wings do houseflies and mosquitoes have?
4. Tell about the mouth parts of houseflies and mosquitoes.
5. How can houseflies walk upside down on a ceiling?
6. Tell why houseflies and mosquitoes may be harmful.

Growing Plants Indoors

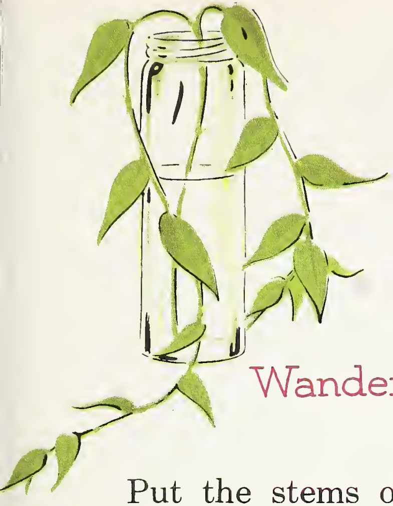


Plants from Cuttings

Ask someone for a few branches of some coleus plants. Put the stems of some of these branches in glass jars of water. Set the jars on a window sill or on a table near a window.

Look at the stems every day. Soon you will see some little roots begin to grow.

How many days did it take for the roots to start growing?



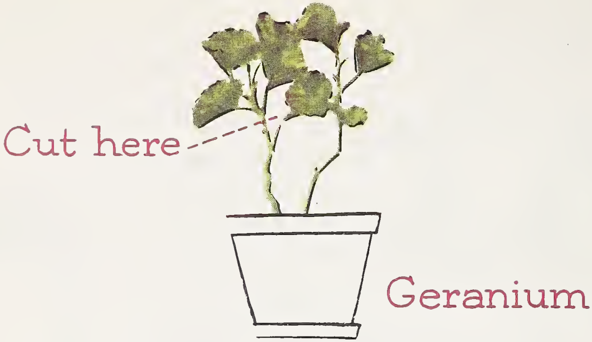
Wandering Jew

Put the stems of some other plants in water. Will they grow roots? Two kinds you may try are shown on this page.

When your plants have many roots, plant them in pots of good soil. Keep the soil moist.

Take some of your plants home. Give some to teachers who have no plants in their rooms. Keep some for your own schoolroom.

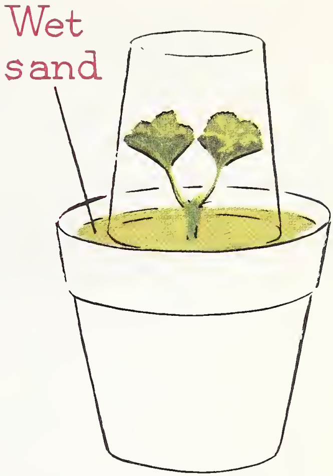
Philodendron



Geraniums from Cuttings

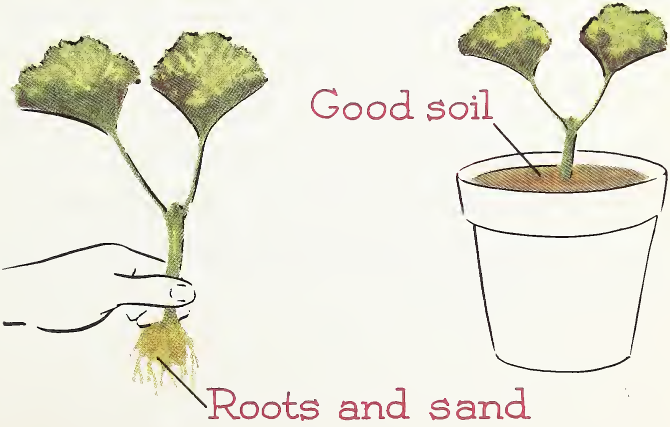
Cuttings from geraniums will grow roots in wet sand.

Cut off the end of a geranium stem. Take off all but one or two small leaves.



Put the cutting in a pot of wet sand. Put a drinking glass over the top. Keep the sand wet.

In about two weeks, there will be roots growing from the cutting. Dig up the cutting and plant it in a pot of good soil. Put the plant in a sunny window. Keep the soil moist but not wet.



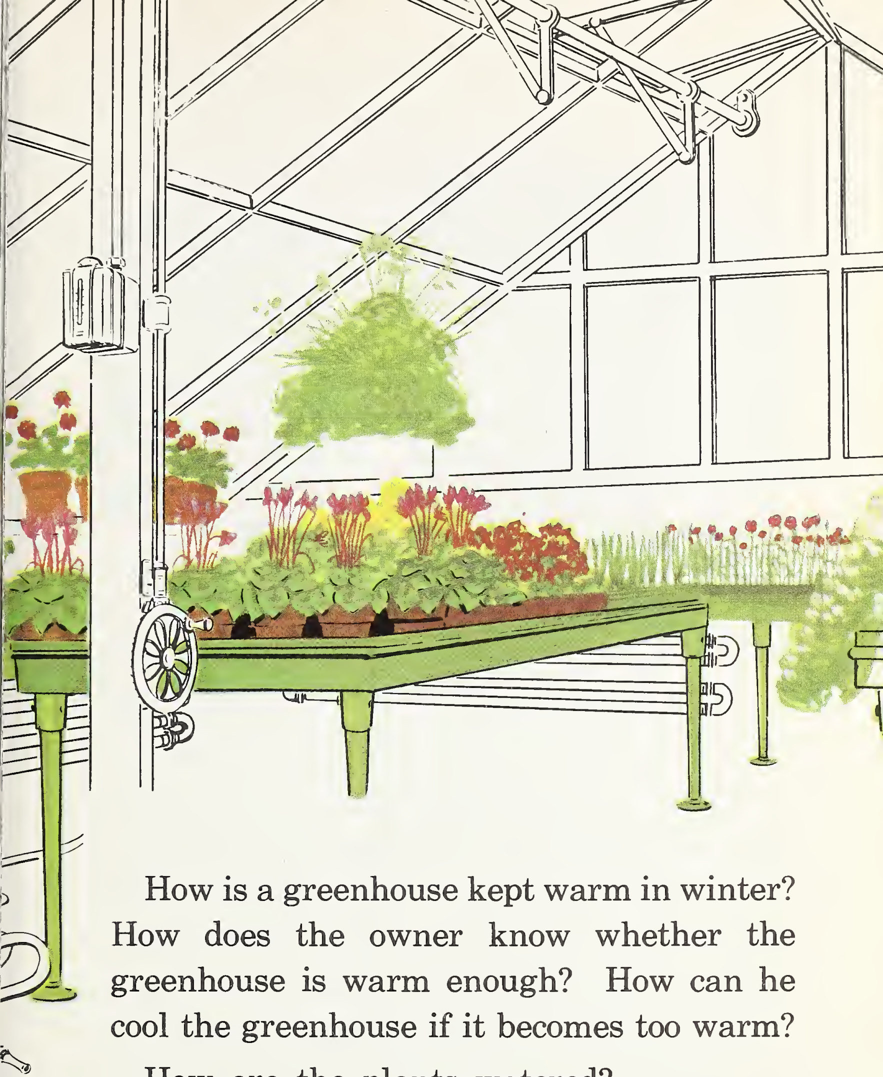
Greenhouses

Most plants will not grow outdoors during cold weather. Plants need warmth to grow.

We can keep such plants in a greenhouse. The plants will grow and many of them will have flowers.

The air inside a greenhouse is warm. Sunlight for the plants comes in through the glass roof and sides.

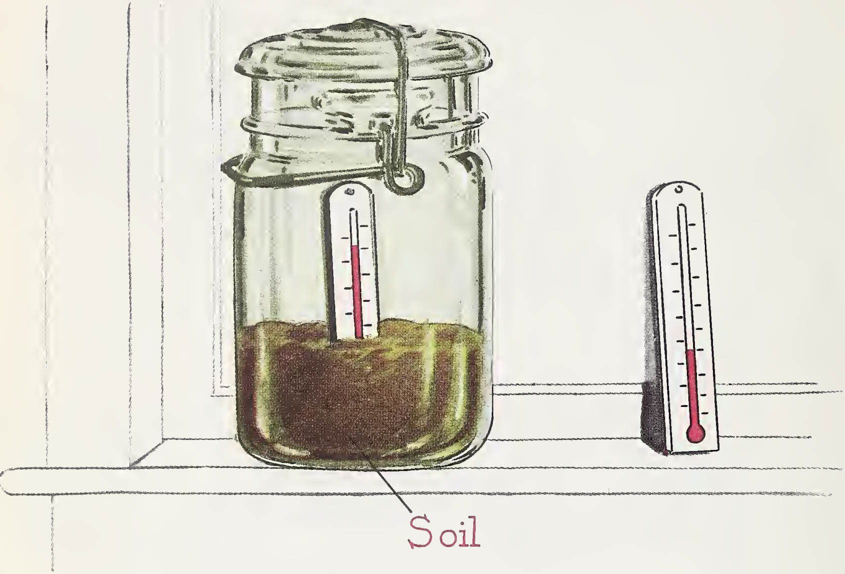
Visit a greenhouse. You will see men planting seeds, bulbs, and cuttings. They sell the plants and the flowers to people who like to have plants and flowers in their homes in winter.



How is a greenhouse kept warm in winter? How does the owner know whether the greenhouse is warm enough? How can he cool the greenhouse if it becomes too warm?

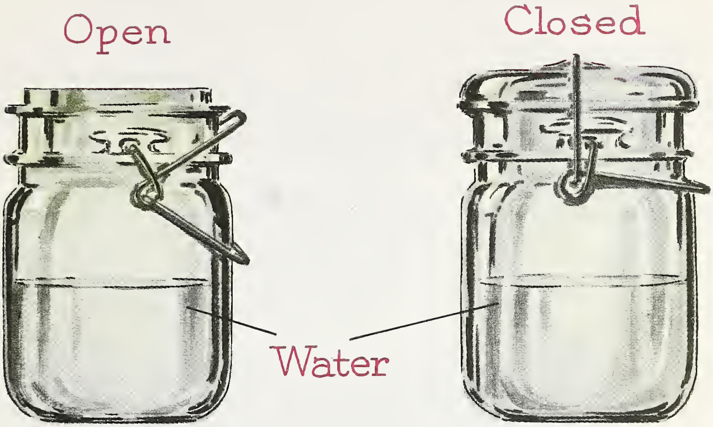
How are the plants watered?

Tell why the air in greenhouses is often damp.



Put two inches of soil in a fruit jar. Set the jar outdoors in sunlight on a cool day. Does the temperature in the jar become higher or lower than the temperature outside the jar, or does it stay the same?

What does sunlight do to the soil and the air inside the jar? Now can you explain why a greenhouse becomes so warm on a sunny day?



Find two fruit jars that are alike. Put the same amount of water in each jar. Close one jar. Leave the other jar open.

Put both jars in a warm place for two or three days. What happens?

Water evaporates in both jars, but the water vapour cannot get out of the closed jar. Soon the air in this jar cannot hold more water vapour. Then the water in the jar stops evaporating.

Water vapour can get out of the open jar. The water in this jar keeps on evaporating. All of it may evaporate.

Making a Winter Garden

Most wild plants will not live in our homes in winter. The air in our homes is too dry.

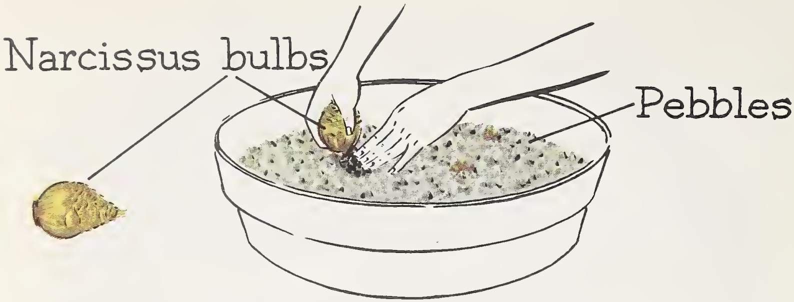
We can raise some of these wild plants by putting them in a glass bowl that has a cover. A saucer makes a good cover. The air in the covered bowl will stay moist.

The plants need some of the same soil they grew in. Put in some sand first, then put in the soil, and then put in the plants. Water the plants a little and put the cover on. You do not need to water the plants again. Can you tell why?

Soon the inside of the glass bowl will be covered with drops of water. Where does this water come from? How did the water get into the air?

Watch the drops on the sides of the bowl. What happens to them?

Set the bowl in sunlight. Which side has the most drops on it? Is this side the cool or the warm side? Can you tell why there are more drops on this side?

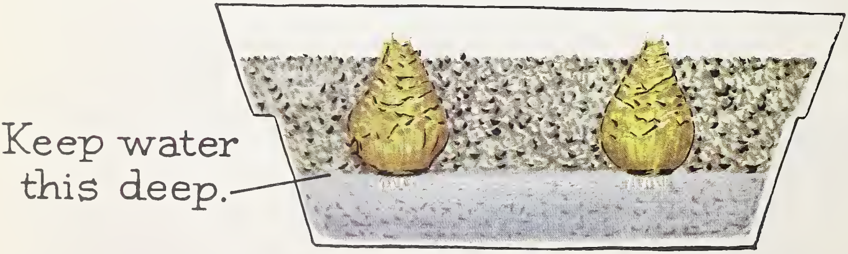


Plants From Bulbs

Bulbs will give you some nice flowers for winter.

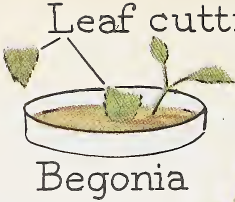
Put small pebbles in a pan that is three or four inches deep. Set some narcissus bulbs in the pebbles. The tops of the bulbs should not be covered.

Pour enough water in the pan to touch the bottoms of the bulbs. Add more water as some of the water evaporates into the air.



Keep the bulbs in a cool place until the buds have grown. A north window is a good place for them.

Watch the buds. When they are ready to open, you may move the plants to a sunny window.



Other Ways of Starting Plants

Some plants send out runners. New plants grow at the ends of the runners. These new plants will grow if you put them in soil.

Some plants will grow from bits of leaves put in the soil. Try to raise plants this way.

---

1. What are some ways we can start plants without seeds?

2. What parts do plants have above ground? What parts do they have below ground?

3. How is a greenhouse kept warm?

4. Why do most plants grow better in a greenhouse than in our homes?

5. Why is the air moist in a winter garden such as you have just made?

Things That Dissolve

Making Things Dissolve

Some boys and girls made lemonade. They squeezed a dozen lemons and put the juice in four quarts of water. They did not like it. Do you know why?

Then they put some sugar in each cup and stirred it. Soon they could not see the sugar. It seemed to be gone.

But the lemonade tasted better. The sugar was really there. It had **dissolved** in water.

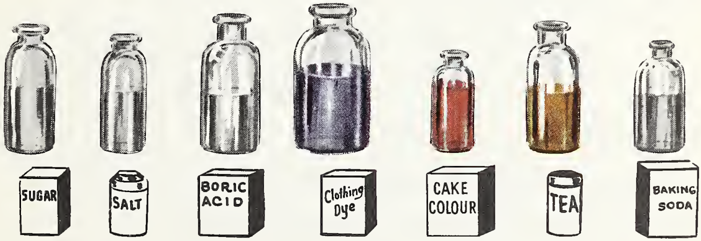
Stir a little sugar in a glass of water and watch it dissolve. Try some clean sand. Does it dissolve?

Try coal, chalk, wood, salt, baking soda, and many other things. Which ones dissolve?

It is fun to dissolve things that are coloured. Buy some cake-colouring tablets. Break off little pieces and dissolve them.

Some kinds of pencils dissolve in water. You can make ink of them.

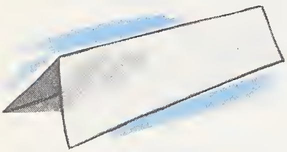
Collect many things that dissolve in water. Dissolve them and put them in bottles. Find out how we use these things.



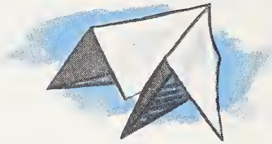
THINGS THAT DISSOLVE

Making and Using a Filter

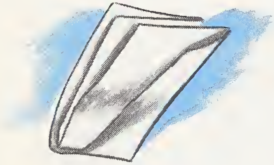
Some things will go through a **filter** and some will not. Will things dissolved in water go through a filter? Let's find out.



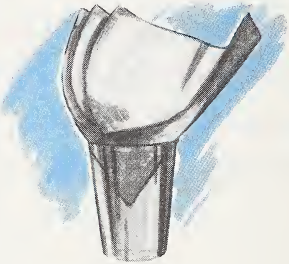
Fold a paper towel like this.



Fold it again like this.

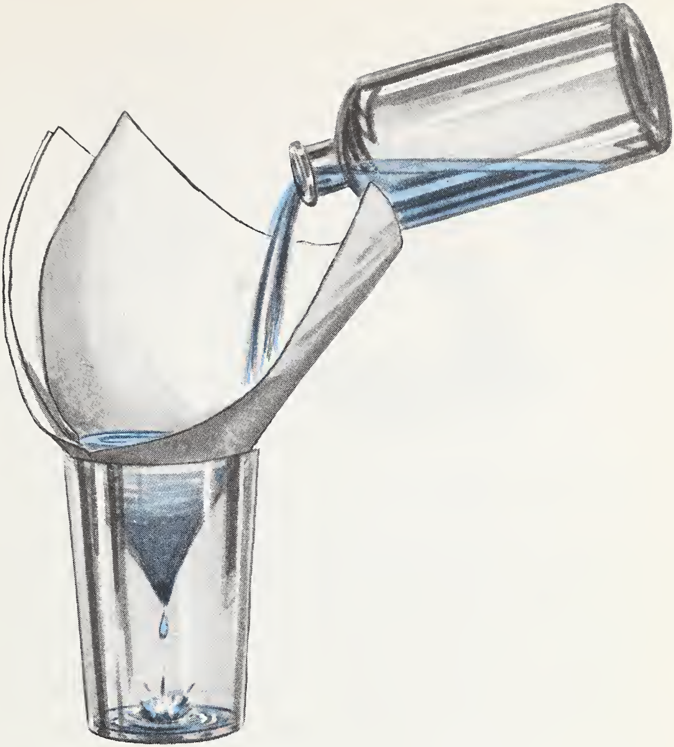


Open the paper towel like this.



Put it in a glass like this.

Your filter will look something like a funnel that does not have a hole.



Pour salt water in your filter. Taste the water that goes through. Is there salt in it?

Try sugar water. Will blue ink go through a filter? Will cake colouring?

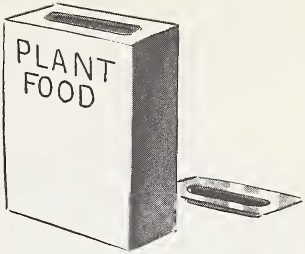
Will muddy water? Will cocoa?

Things that do not go through the filter are not dissolved in the water. They are just mixed with the water.

Secret Ink

Put a little water in a small dish. Dissolve as much baking soda as you can in the water. Write a secret message with the baking soda water. Use a new pen that has never touched ink.

To read the secret message, warm the paper very carefully over a candle flame. Be careful not to hold the paper too close to the flame or it may catch fire.



Helping House Plants

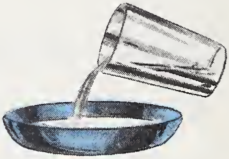
House plants need certain **minerals** to grow well. The plants sometimes use most of the minerals in the soil. You may put more minerals in the soil for the plants.

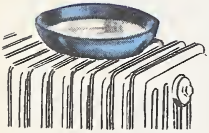
Buy a package of these minerals and dissolve them in water following the directions on the package. Water some house plants with these minerals.

Evaporating Salt Water

Dissolve as much salt as you can in a glass of water.

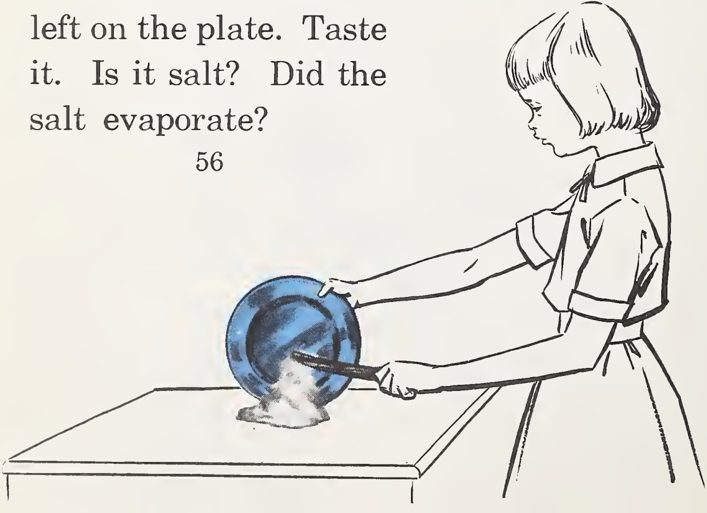
Pour a little of the salt water on a plate. Set this in a warm place.

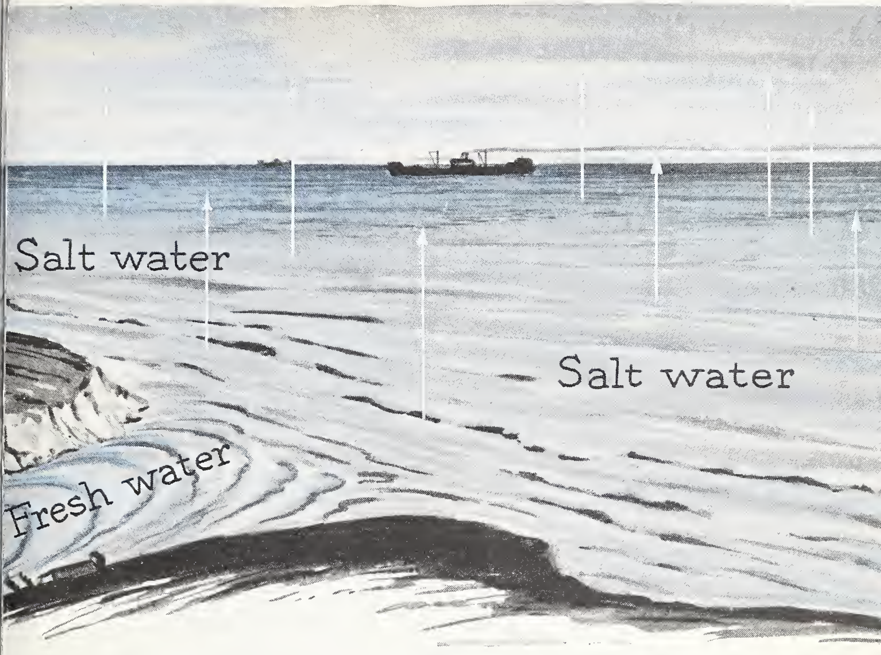




Wait until all the water has evaporated.

Scrape out what is left on the plate. Taste it. Is it salt? Did the salt evaporate?





If you have ever been swimming in the ocean you have probably tasted the water.

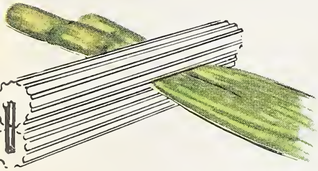
Ocean water tastes salty. Salt and many other minerals are dissolved in it. That is why ocean water is called salt water.

When ocean water evaporates, the minerals do not evaporate with it. They stay in the ocean. That is why the ocean is always salty.

Making Cane Sugar

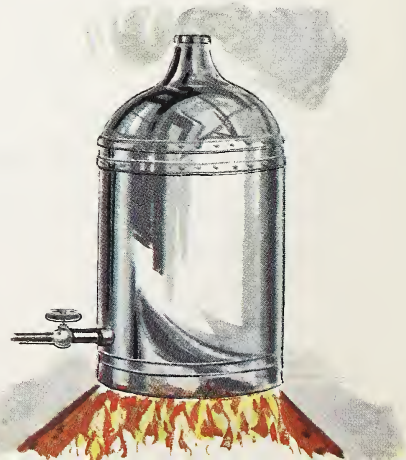
Much of our sugar comes from the plants called sugar cane.

The plants are filled with a juice called **sap.** There is sugar dissolved in the sap.



The sugar cane is cut and then pressed between heavy rollers. The rollers squeeze out the sweet sap.

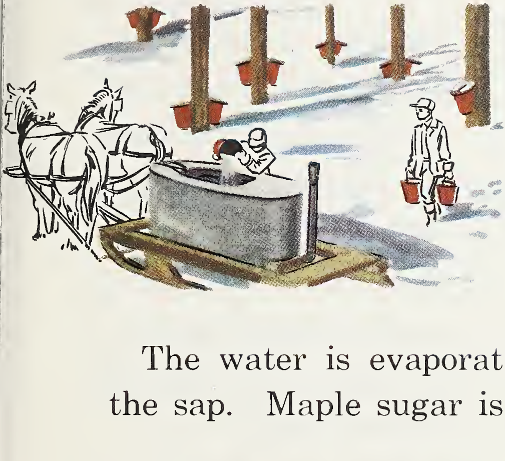
The sap is then heated in big tanks. The water evaporates from the sap, and the sugar is left in the tank.



Making Maple Sugar

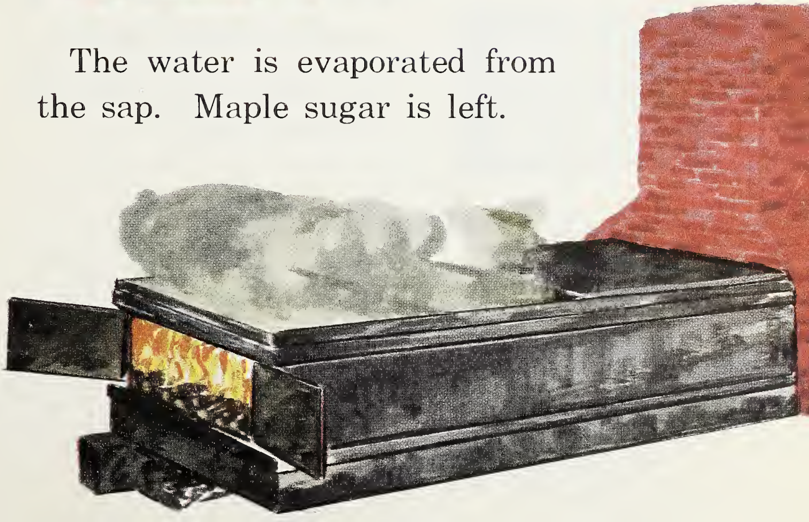
Maple sugar is made from the sweet sap of sugar maple trees.

Little holes are made in the trees in early spring. The sap drips out into pails.



The sap is carried to the sugar-making house.

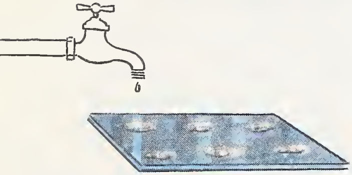
The water is evaporated from the sap. Maple sugar is left.



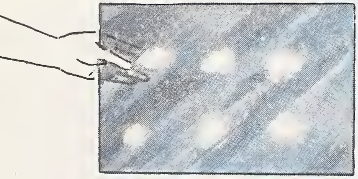
Minerals in Drinking Water

In some parts of the country, the drinking water has many minerals dissolved in it. Try this test on your drinking water.

Clean both sides of a piece of glass.

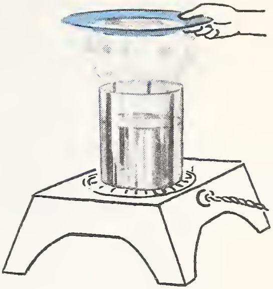


Put a few drops of drinking water on the glass. Wait until the water evaporates. How can you make it evaporate faster?



Is anything left on the glass? Where did it come from?

Water that has minerals dissolved in it is called "hard water." Is your drinking water hard?



Rain Water

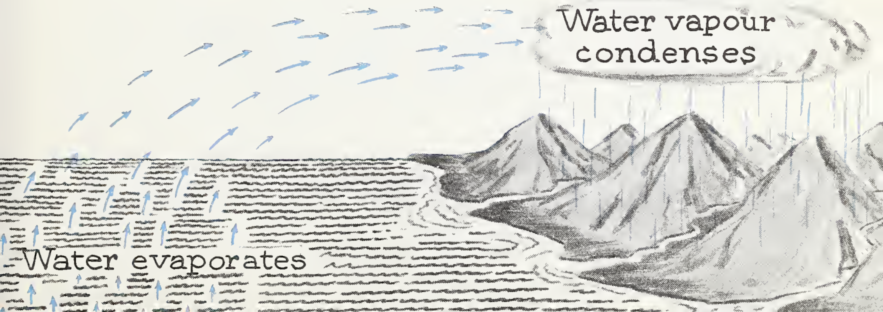
Boil some salt water. Hold a clean plate over the boiling water.

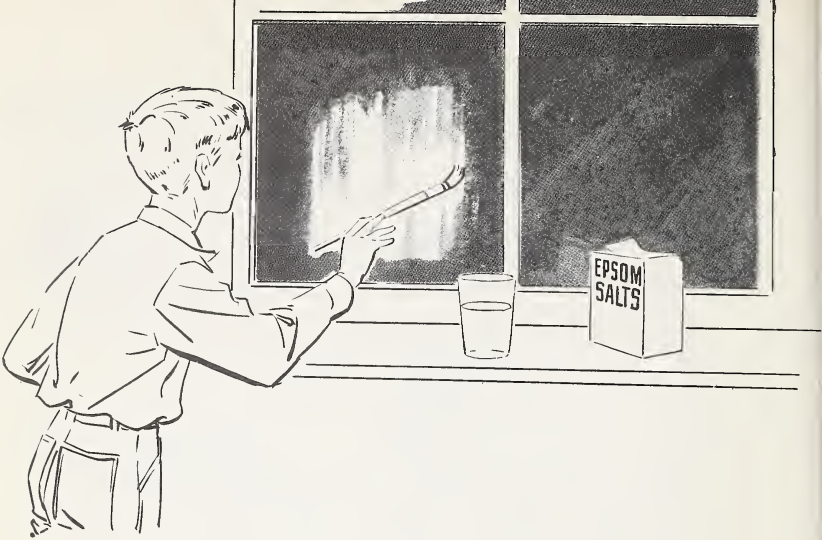
Soon there will be drops of water on the plate. Taste them. Are they salty?

Rain is made when water evaporates and condenses again. Some of the water in rivers and oceans changes into water vapour. Then some of the water vapour condenses into rain.

Dirt in rivers and salt in oceans do not evaporate. Rain water is clean. Almost nothing is dissolved in it.

Test some rain water to see if there are minerals dissolved in it.

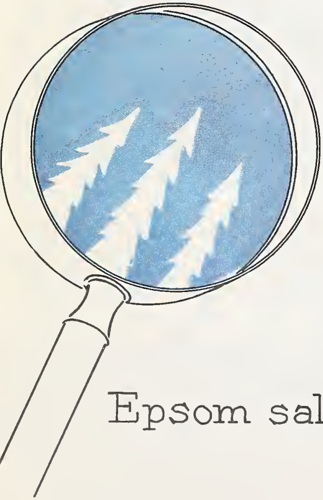




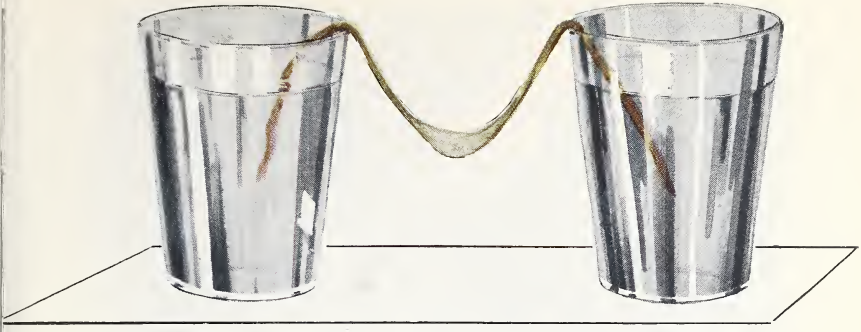
Crystals

Sometimes the minerals dissolved in water take certain shapes when the water evaporates. We call them **crystals.**

Add Epsom salts, a little at a time, to a glass of hot water until no more will dissolve. Dip a brush in the water and paint a piece of glass with it. Use a hand lens to watch the water evaporate.



Epsom salt crystals



Here is another way to make a crystal. Dissolve Epsom salts in two glasses of hot water. Wet a string and put one end in each glass of water as shown. In an hour or so, look at the string.

Perhaps you can find out about other kinds of crystals you can make. Look at these crystals with a hand lens. Each kind has its own shape.

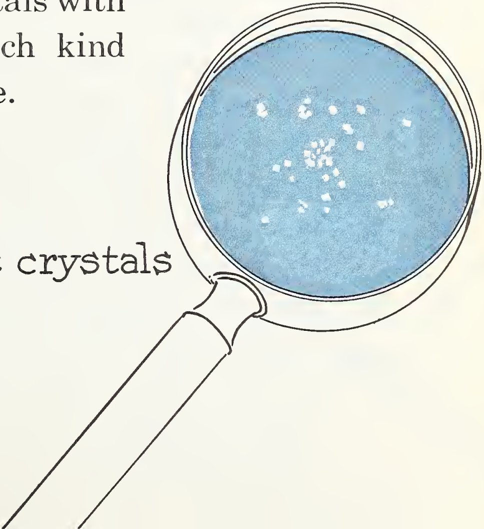
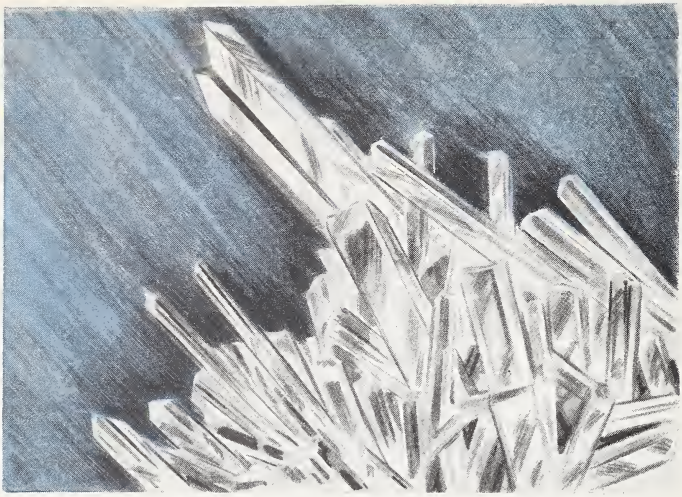


Table salt crystals

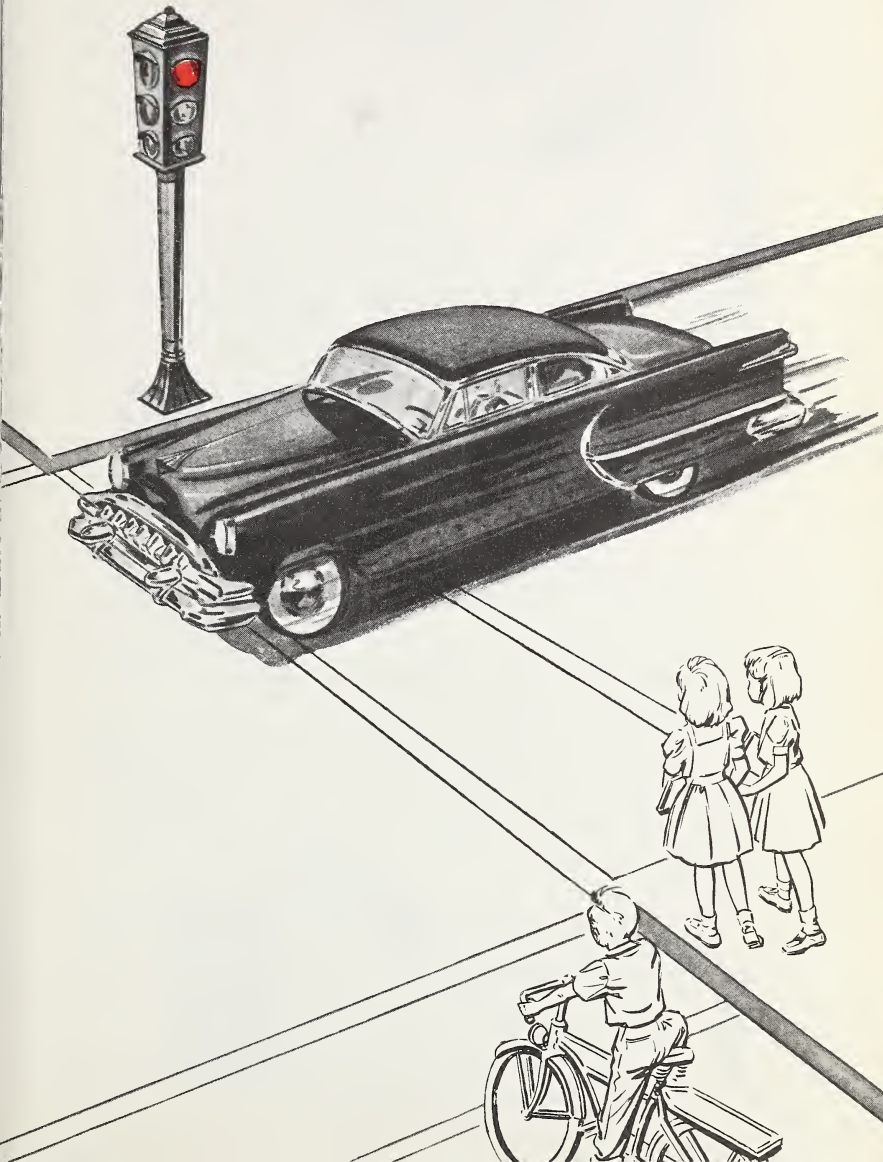


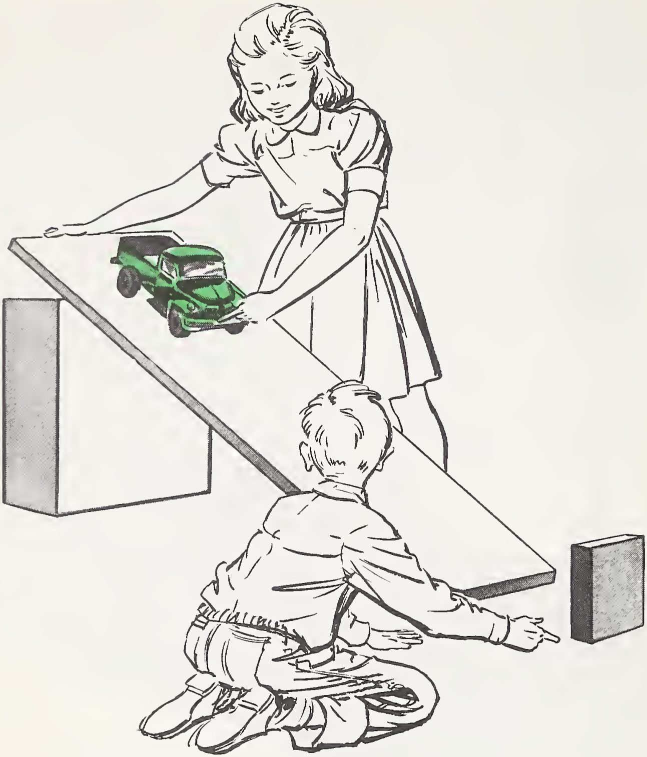
Sometimes people find crystals in rocks. Many crystals were made from minerals that were dissolved in water in the ground.

---

1. What are some things that dissolve well in water?
2. What are some things that do not dissolve well in water?
3. How is cane sugar made?
4. What is hard water?
5. How can you make crystals?
6. How can you tell whether something dissolves in water or whether it just mixes with water?

Stopping Safely

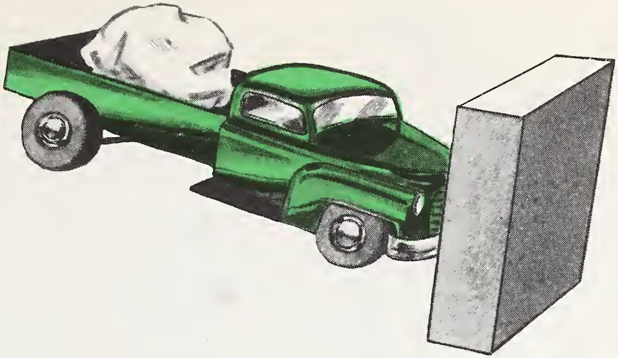




Moving Things Have Energy

Put a toy truck on a board as shown. Let the truck roll down the board and hit a block of wood. How far does the block move?

The moving truck has energy. The energy of the truck makes the block move.

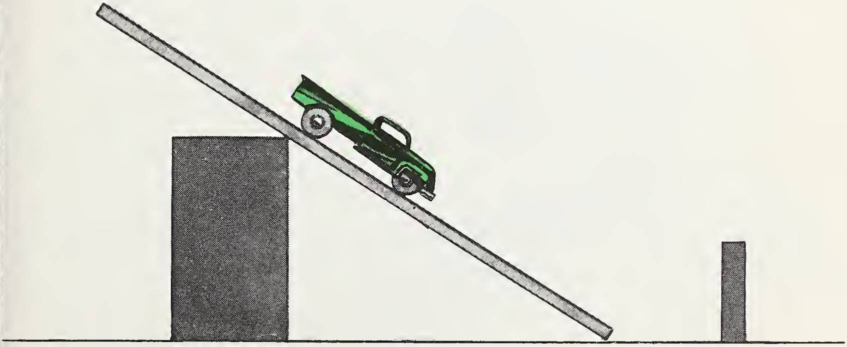


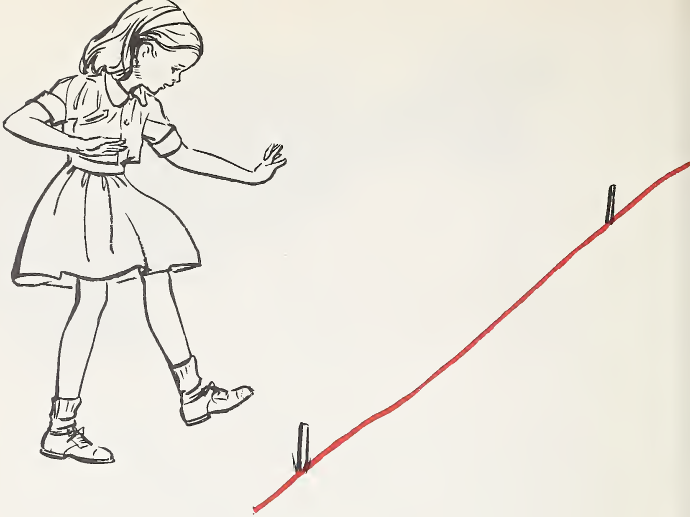
Put a stone in the toy truck. Let the truck roll down the board and hit the block. How far does the block move this time?

Tip the board more, so that the truck moves faster. How far does the block move?

How does more weight change the energy of the moving truck?

How does more speed change the energy of the truck?

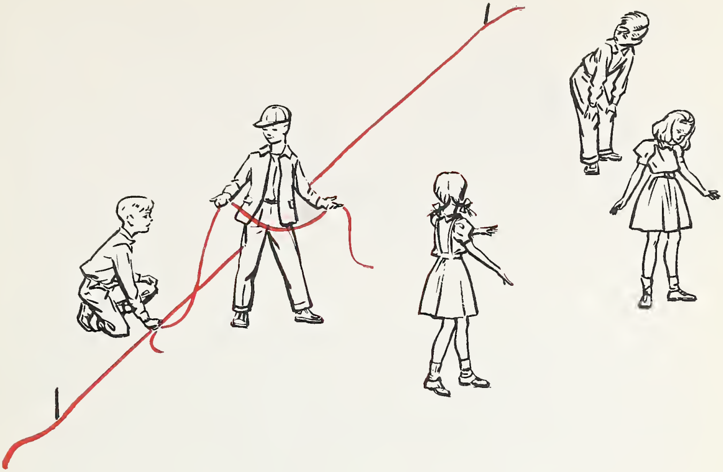




Stopping Distances

Lay a string on the ground between two stakes. Walk up to the string and try to stop on the line. Can you do it?

Now run up to the line as fast as you can and then try to stop. How far over the line did you go?

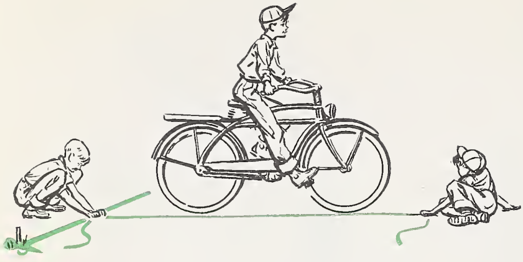


The distance between the place where you try to stop and the place you really stop is called the stopping distance.

The faster you move, the more energy you have and the harder it is to stop. You need a longer stopping distance when you move fast.

Let everyone in the class run up to the line as fast as he can. Measure the stopping distance of each one.

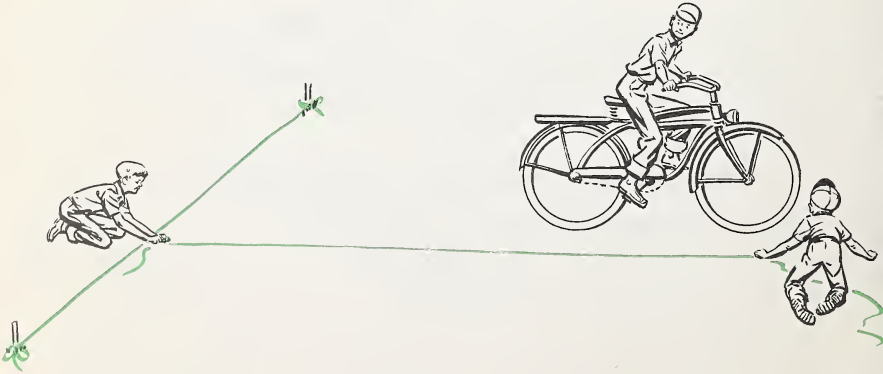
Why should everyone know how much his stopping distance is?



Ride a bicycle slowly across a line. When the front wheel is on the line, put on the brakes. How far do you go before you stop?

Ride up to the line as fast as you can go. Put on the brakes when the front wheel is on the line. How far do you go this time? Why do you go farther?

Why should every bicycle rider know about stopping distances?



Stopping Distances of Automobiles

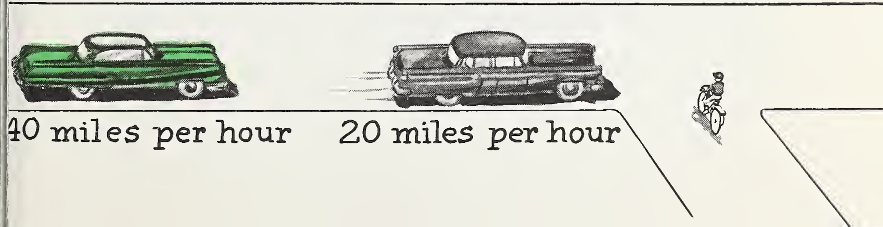
Speed	Distance
20 miles per hour	30 feet
40 miles per hour	120 feet

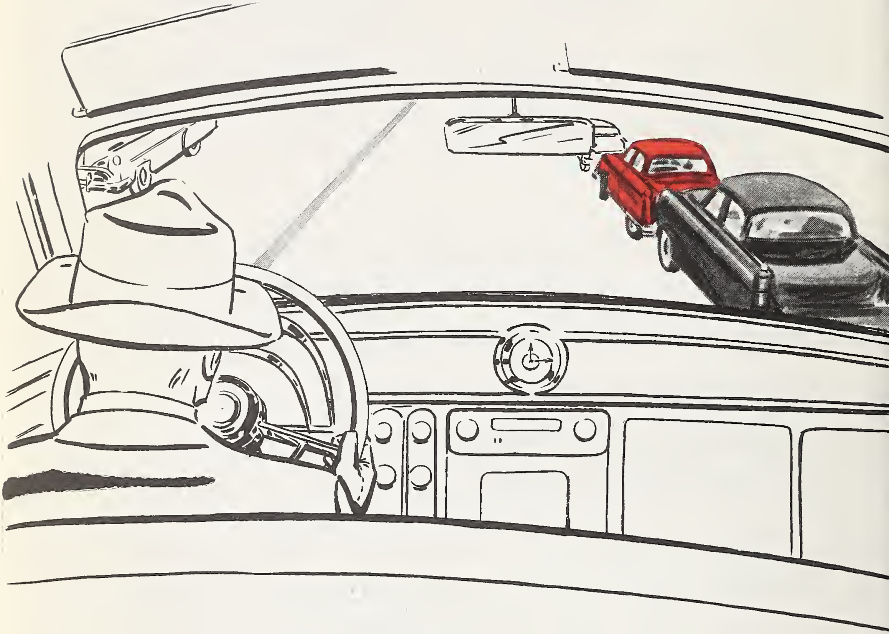
A car with good brakes needs about 30 feet to stop when it is going 20 miles an hour. It needs about 120 feet to stop when it is going 40 miles an hour.

Measure these distances on the side of a street so that you can see how long they are.

Look at the picture below. Suppose the boy on the bicycle rides out from the side street. The black car could stop in time if it were 30 feet away. How far away would the green car need to be?

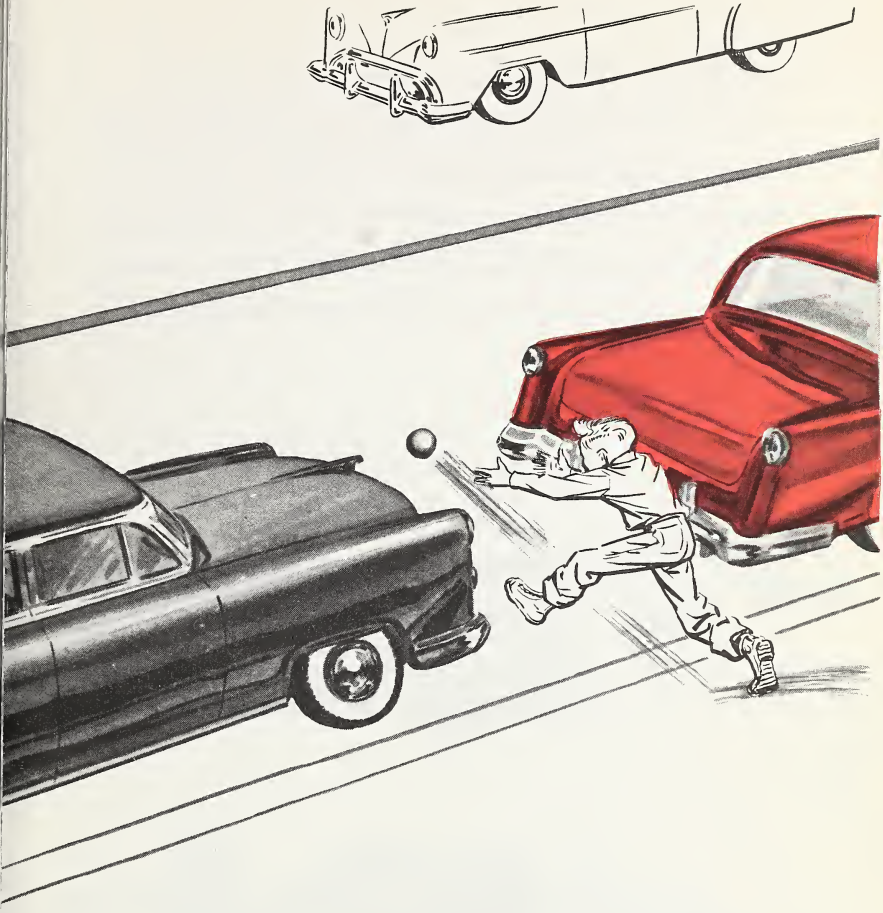
Why is it important to know about stopping distances?





This is what a driver may see as he drives along the street. Does everything seem safe?

What are some things that may happen? Look at the next page.

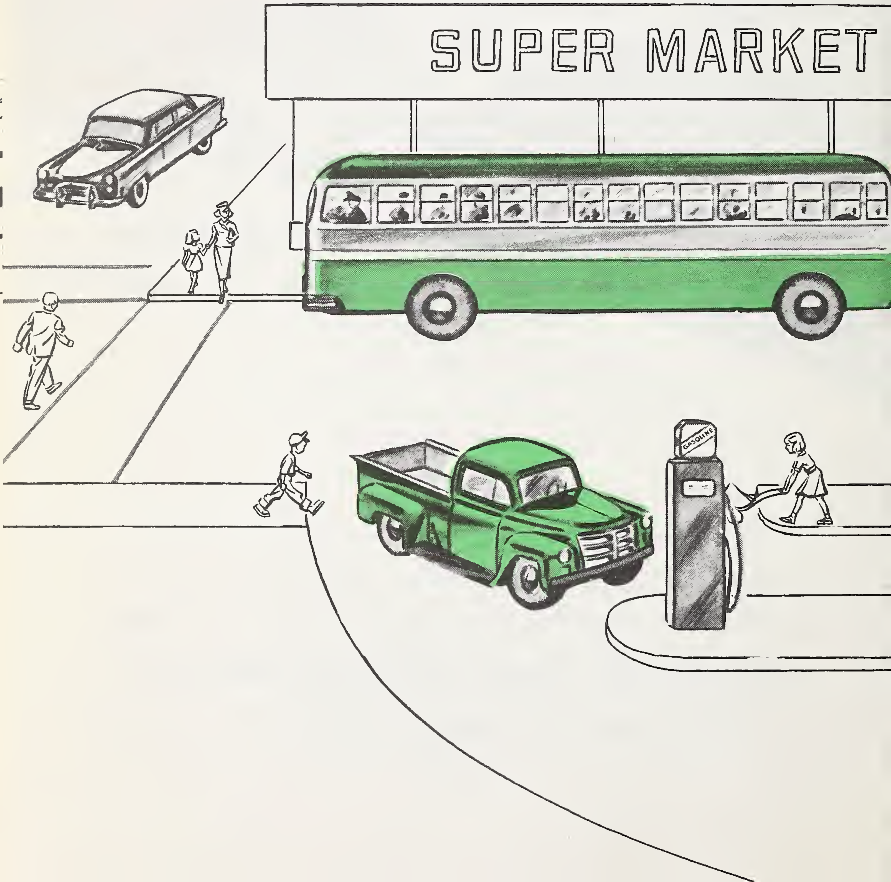


This is what a boy may see as he runs after his ball. Does everything seem safe?

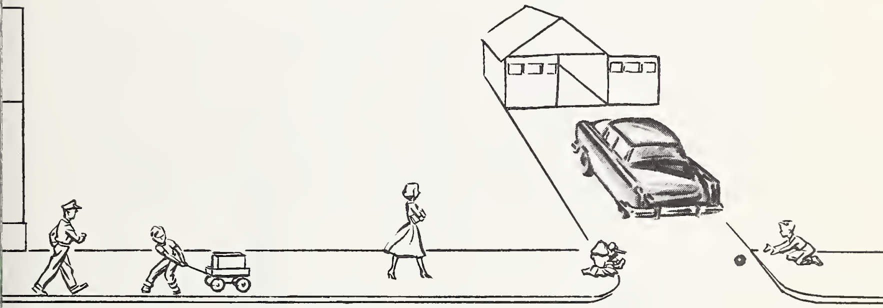
What may happen?

Danger Spots

In the picture on these pages there are many places that are not safe for people who are walking. Find as many of these places as you can. Tell what people could do in each place to keep from being hurt.



Around your school there may be places where people are not safe when they are walking. Make a list of these places. Draw a map showing where they are. Make up some rules that will help keep you safe in these places.

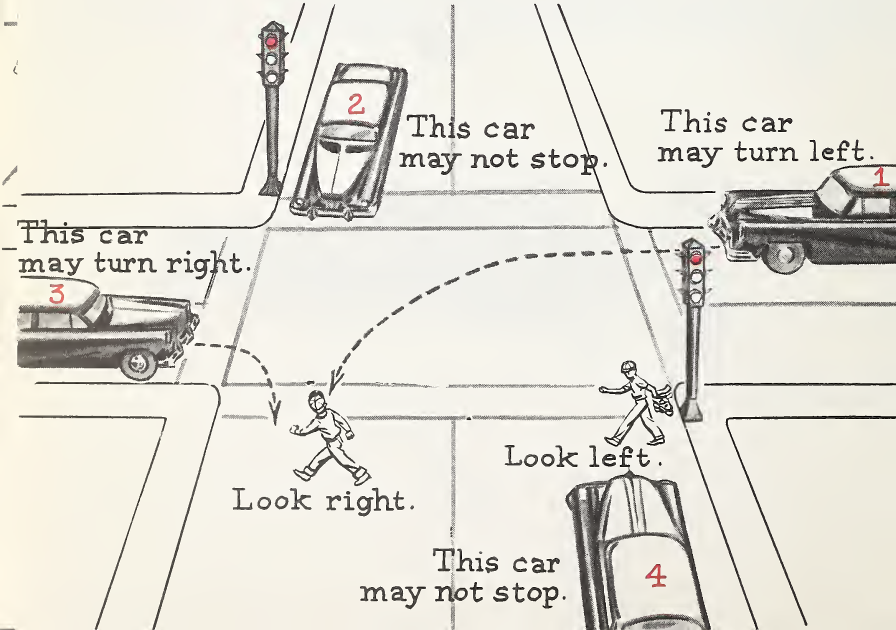


Crossing Streets

Everyone should know how to cross streets safely. Many people are hurt because they do not know how.

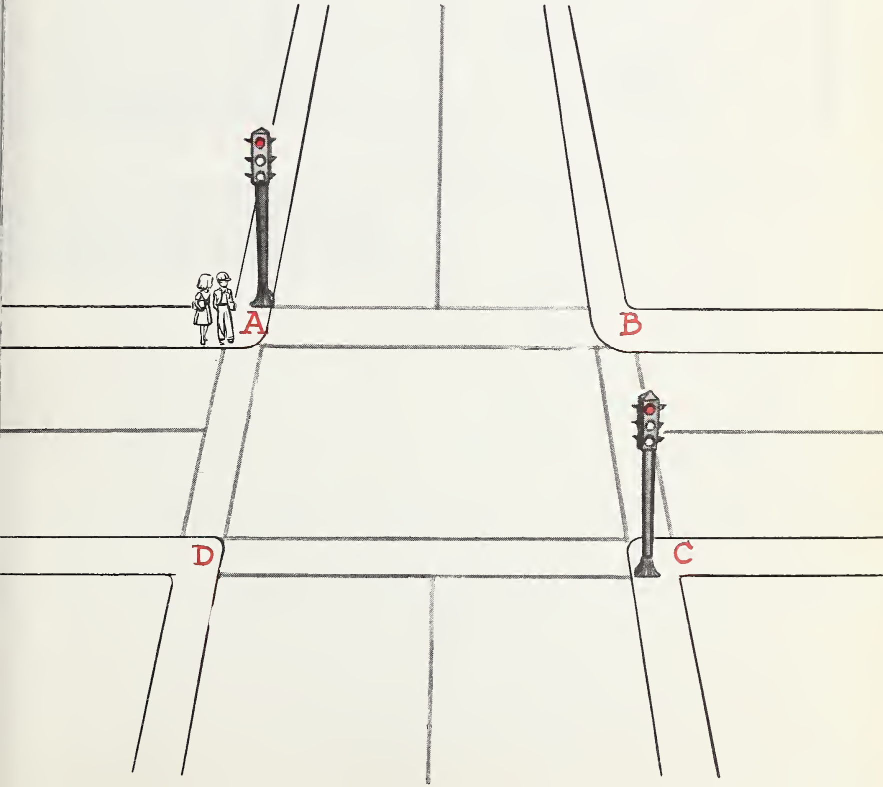
What are three ways an automobile driver may go when he sees a green light? What should a driver do when he sees a red light? Can you be sure he will stop?

You should look both ways before crossing a street. Why? Then you should look left until you reach the middle of the street. Why? Then what should you do? Why?


2
This car may not stop.
This car may turn left.
1
This car may turn right.
3
Look left.
Look right.
This car may not stop.
4

Tell what you should do when you cross the street from A to B. What should you do when you cross from B to C? How would you cross from B to D?

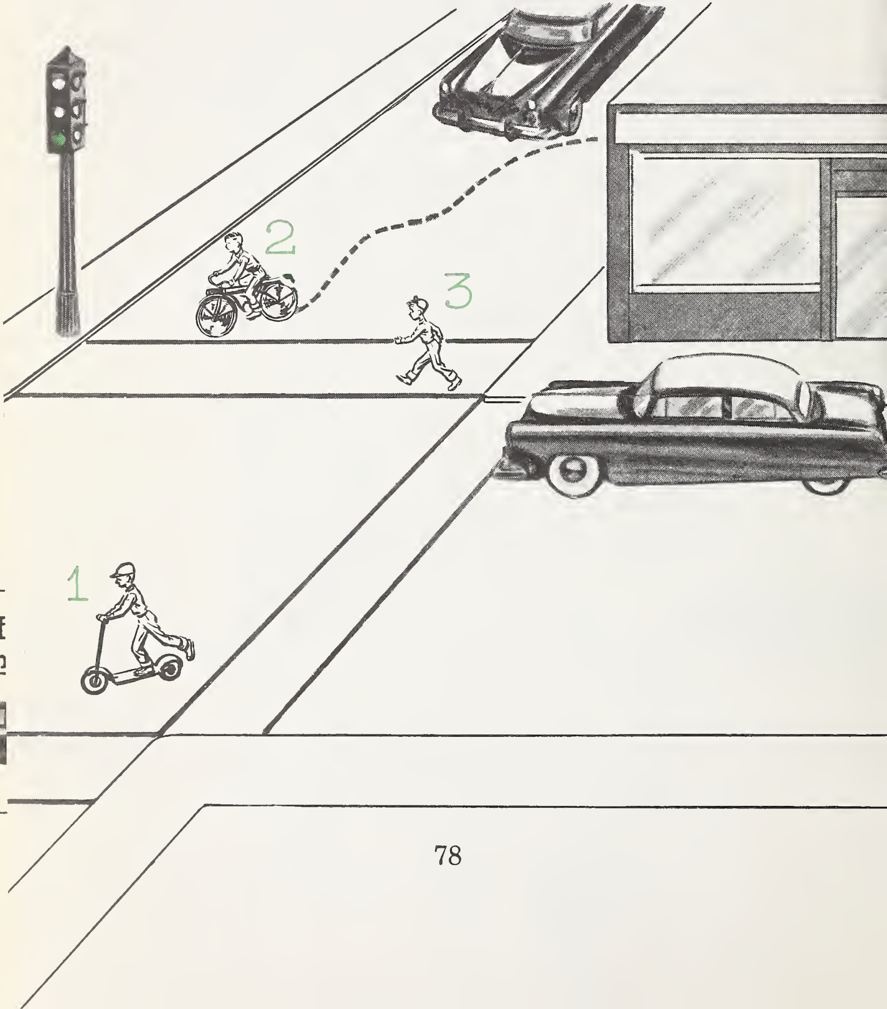
What should you do if there is a policeman at the crossing instead of a light? How do you know when a policeman wants you to cross? How do you know when a policeman wants you to stop?



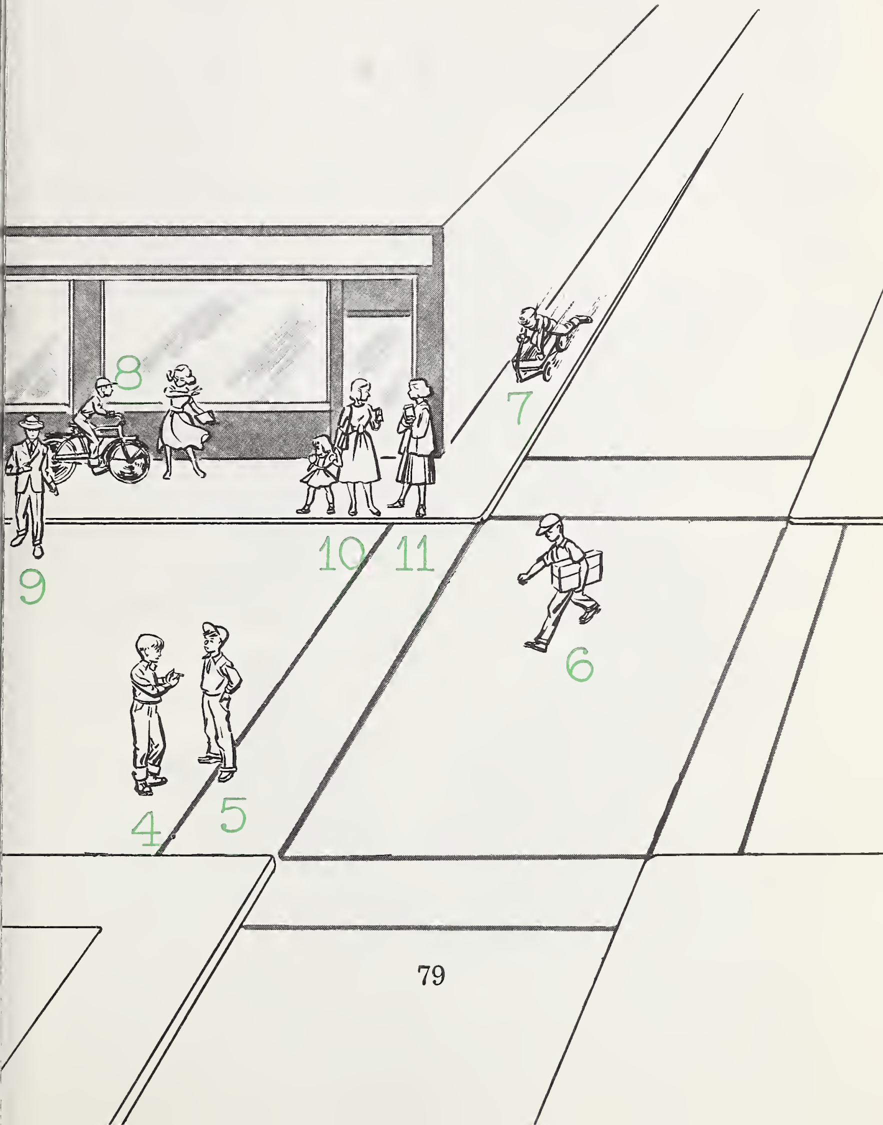
Carelessness

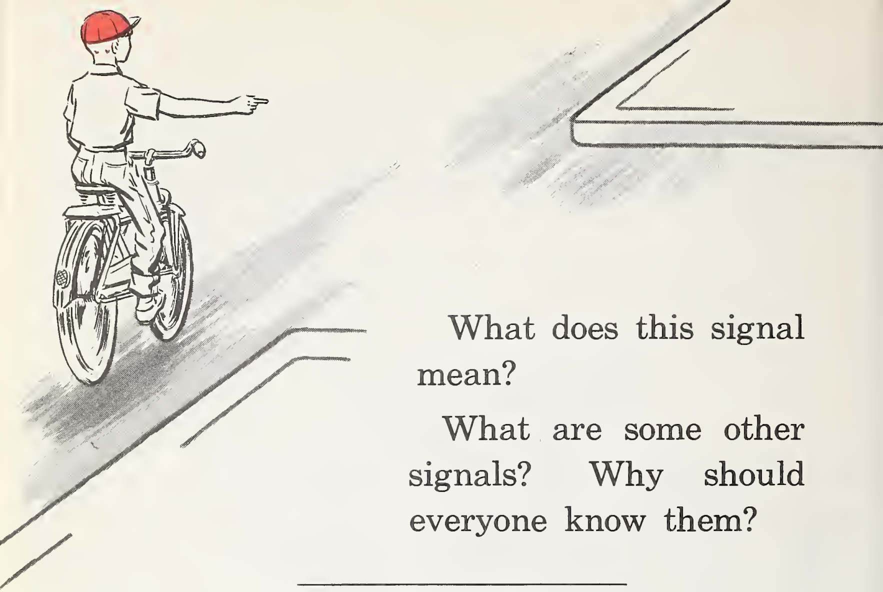
Do accidents just happen or do people do unsafe things?

What do you think?



What unsafe things are people doing in these pictures? Tell why each one is unsafe.





What does this signal mean?

What are some other signals? Why should everyone know them?

---

1. Does a car have more energy when it is moving rapidly or when it is moving slowly?
2. Why does a car going 40 miles an hour need a longer stopping distance than a car going 20 miles an hour?
3. Why is it dangerous to cross a street in the middle of a block?
4. What should you do when you cross a street where there is a light?
5. What should you do when you cross a street where there is no light?
6. What are some good rules to follow when you ride a bicycle?
7. What causes most accidents?

Birds in Winter

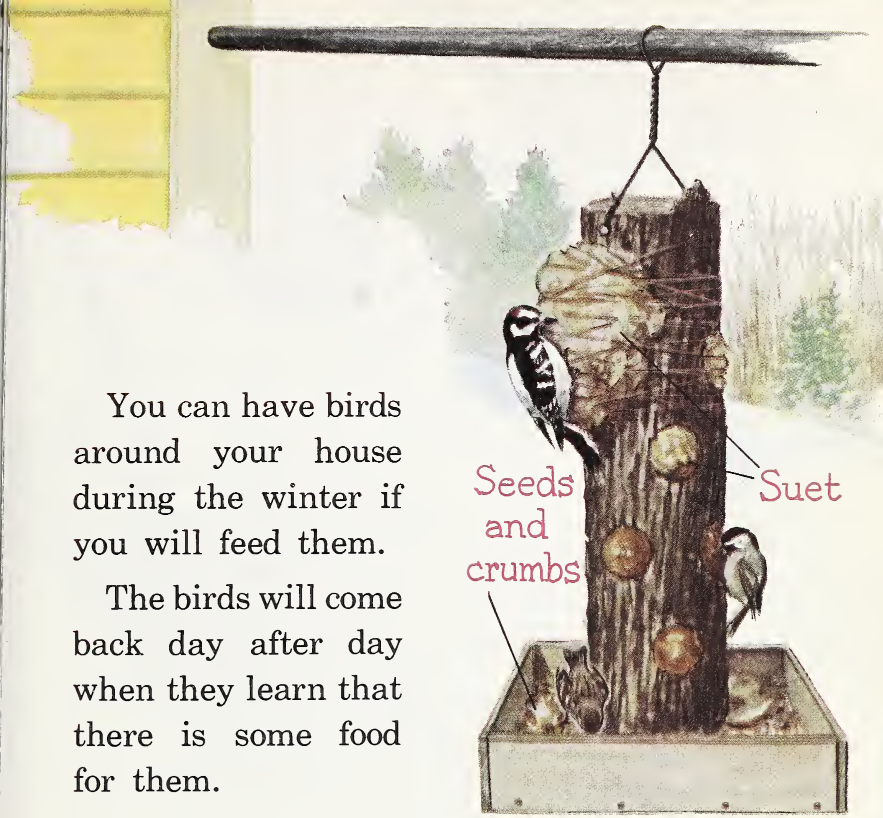
What Birds Eat in Winter

There is not as much food for birds during a cold winter as in summer. Many birds must find different foods when winter comes.

What are some things birds eat in summer? What are some foods they can find in winter?

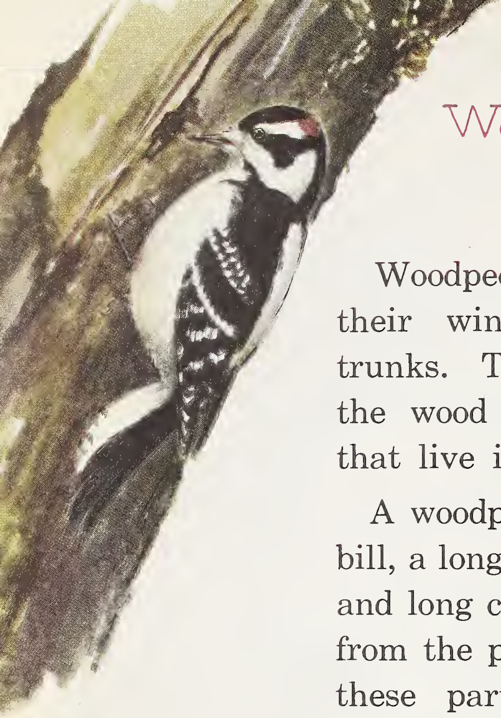
You can have birds around your house during the winter if you will feed them.

The birds will come back day after day when they learn that there is some food for them.



Bird feeder

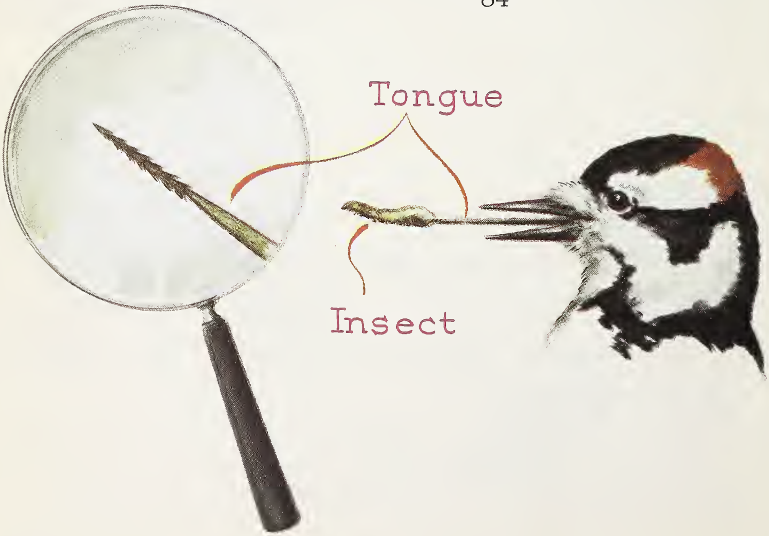
Remember to feed them every day. Birds do not think the same way we do. They will come back again and again even to an empty feeder instead of looking for food somewhere else.



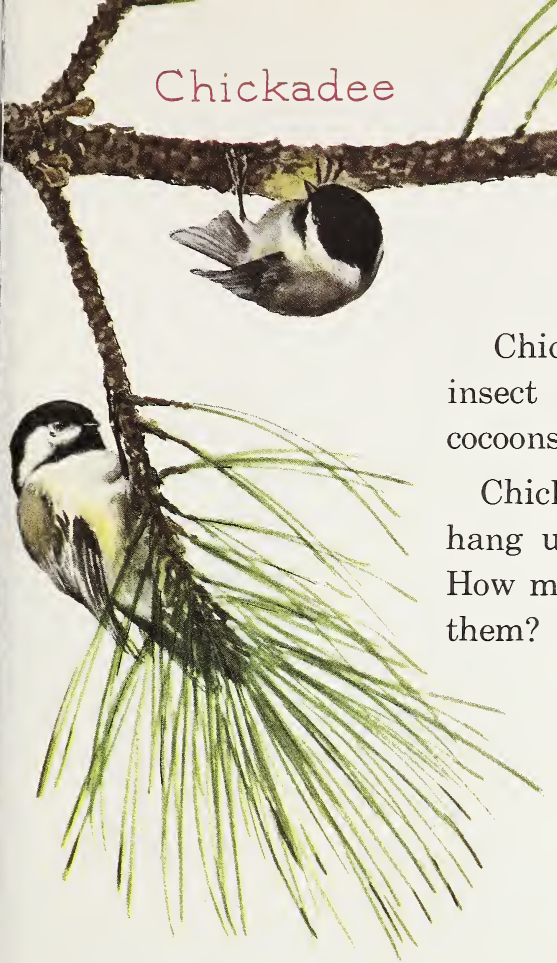
Woodpecker

Woodpeckers find part of their winter food in tree trunks. They make holes in the wood and catch insects that live in the tree.

A woodpecker has a strong bill, a long tongue, a stiff tail, and long claws. Can you see from the picture how each of these parts helps a woodpecker?



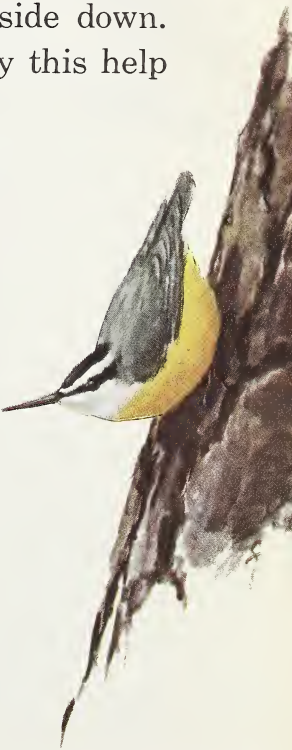
Chickadee



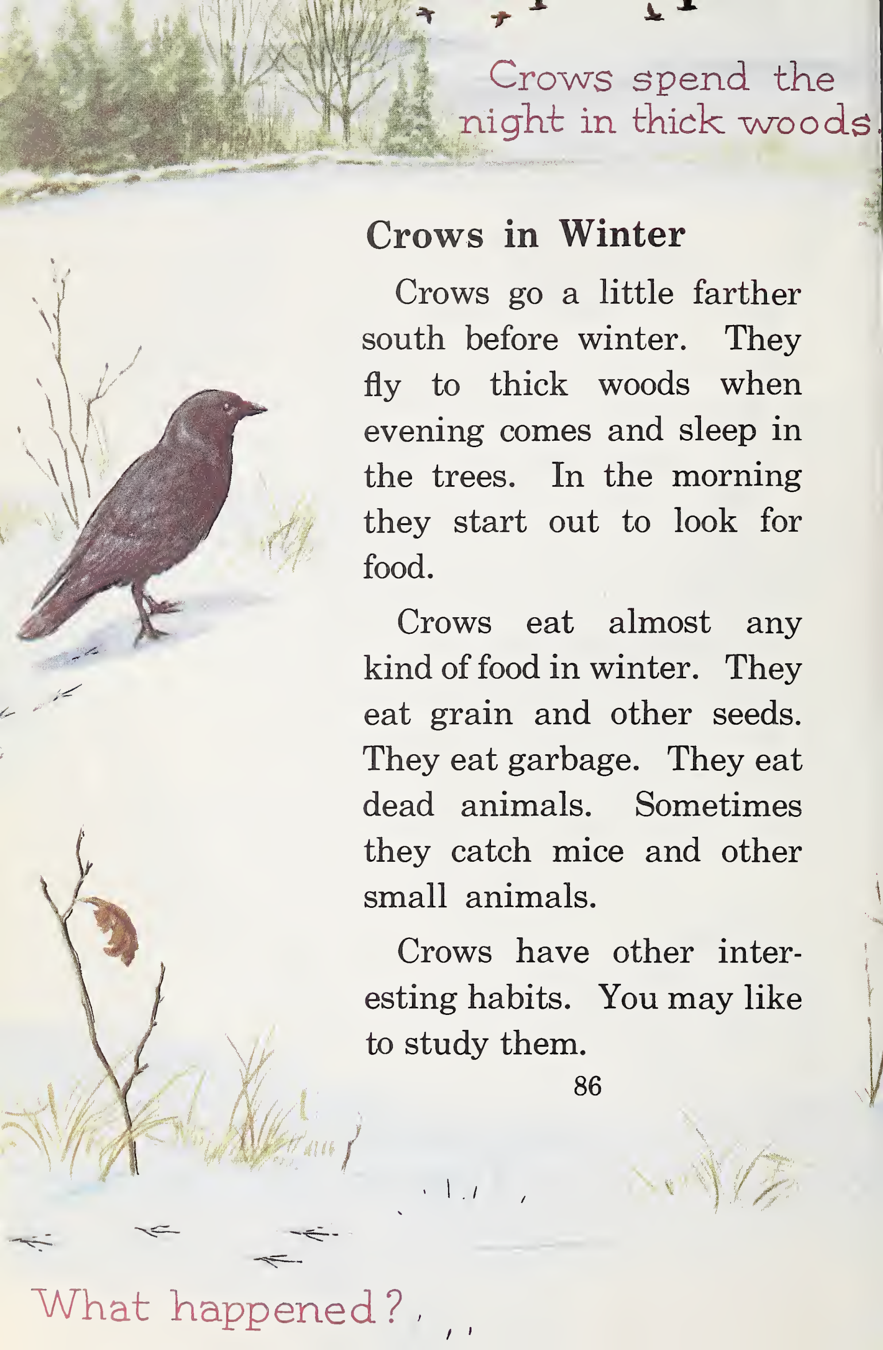
Chickadees find insect eggs and cocoons on twigs.

Chickadees can hang upside down. How may this help them?

Nuthatches can walk up and down trees. They look for insects, insect eggs, and cocoons in cracks in the bark.



Nuthatch



Crows spend the night in thick woods.

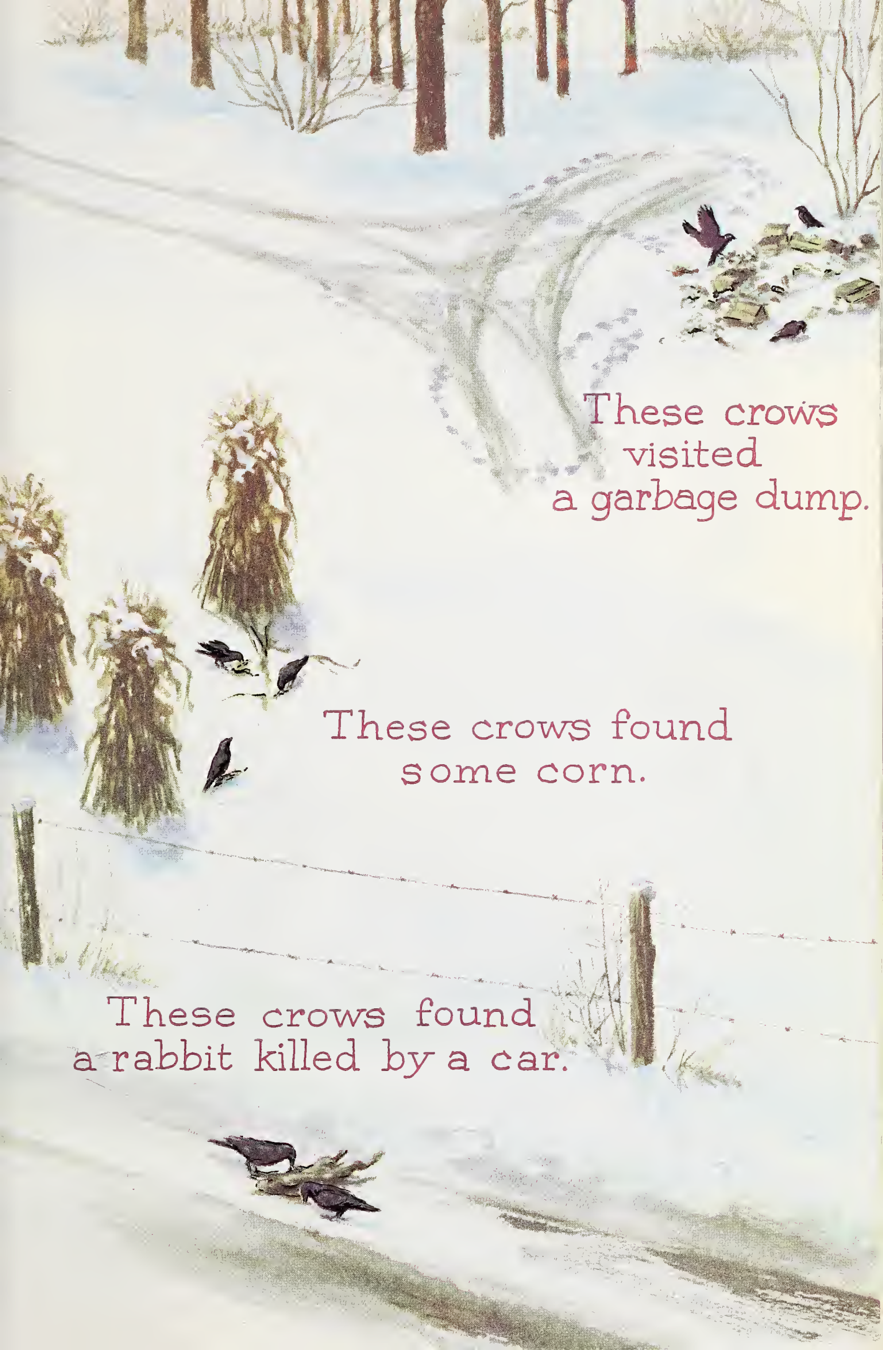
Crows in Winter

Crows go a little farther south before winter. They fly to thick woods when evening comes and sleep in the trees. In the morning they start out to look for food.

Crows eat almost any kind of food in winter. They eat grain and other seeds. They eat garbage. They eat dead animals. Sometimes they catch mice and other small animals.

Crows have other interesting habits. You may like to study them.

What happened?



These crows visited a garbage dump.

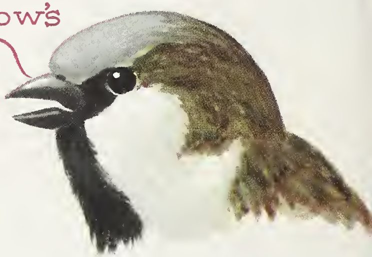
These crows found some corn.

These crows found a rabbit killed by a car.

Winter Birds That Eat Seeds

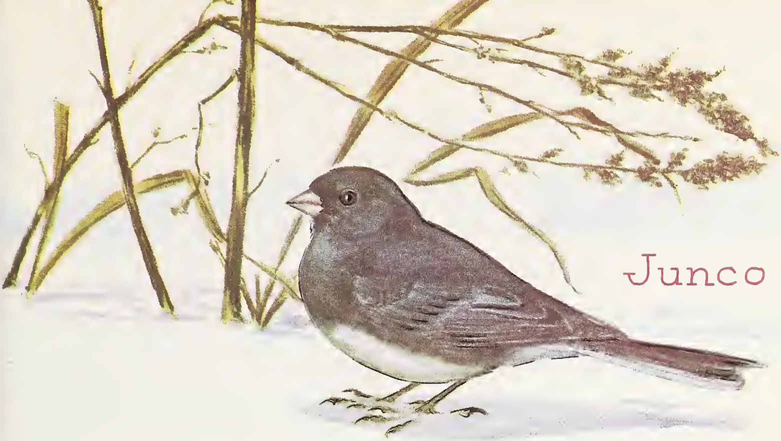
Sparrows look for seeds in the winter. Sometimes the snow is very deep and covers the seeds. Then the sparrows may not find enough to eat.

English sparrow



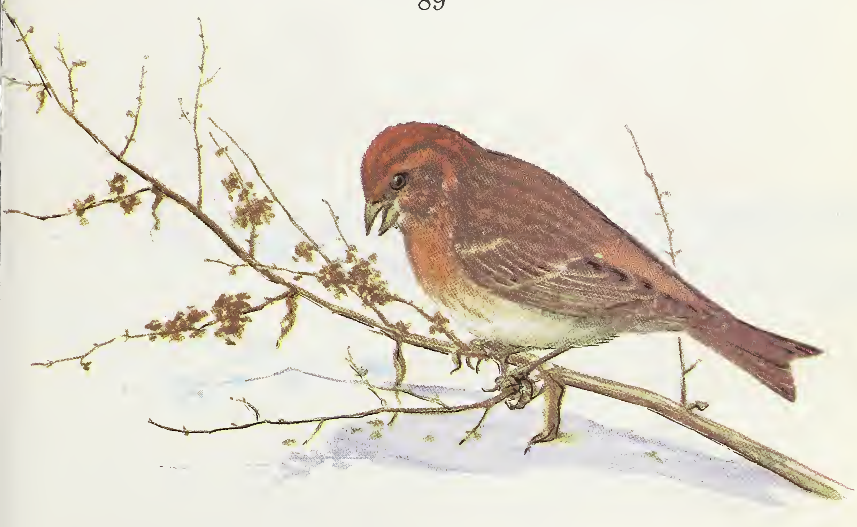
A sparrow's bill

Do sparrows hop or walk?



Junco

In many parts of Canada you may see these two seed-eating birds in winter. They come from farther north where they live in summer.



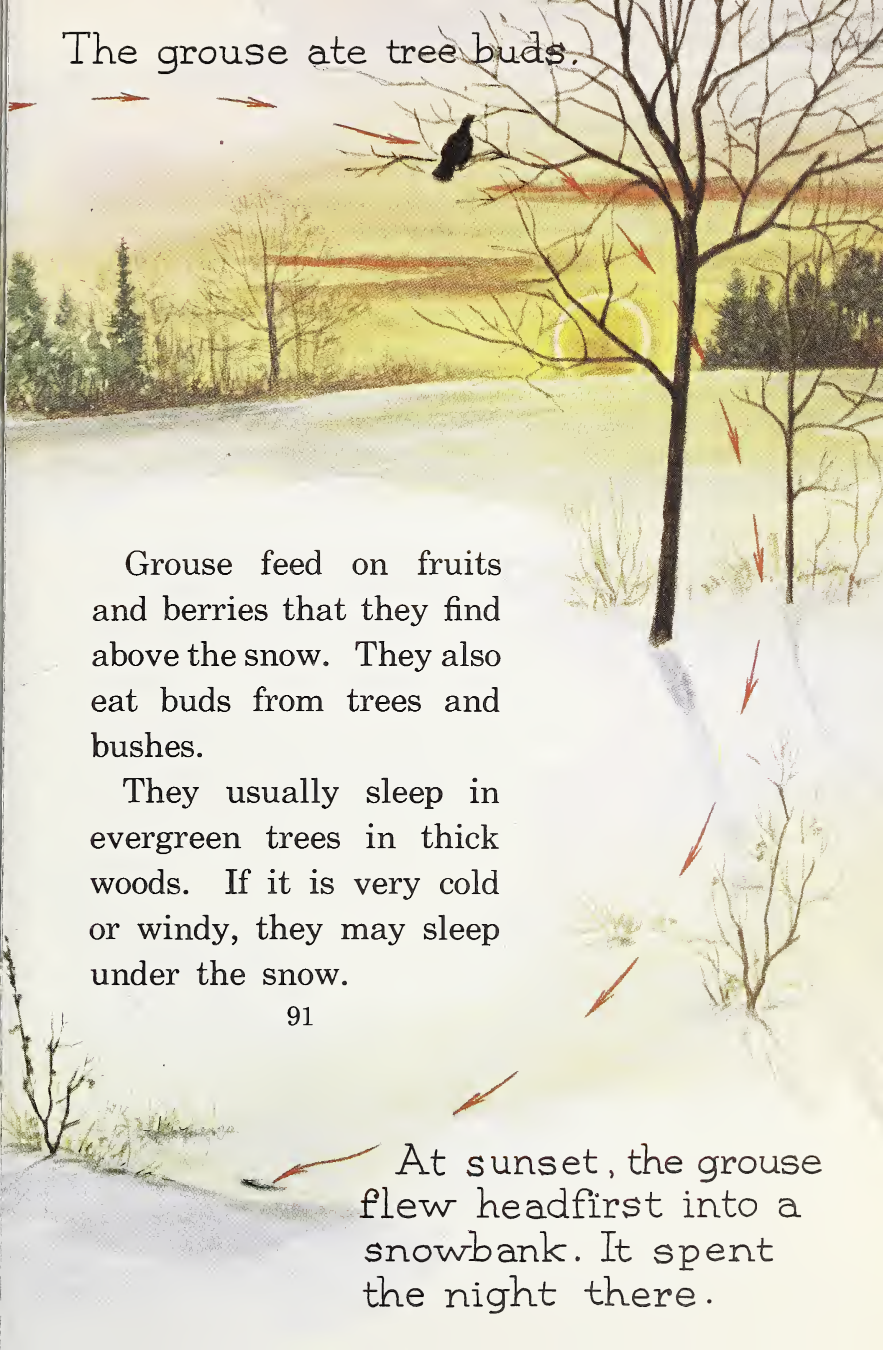
Purple finch

Grouse in Winter

Grouse live in places where the winters are often cold and where the snow is often deep. Many seeds and fruits that the grouse might eat are buried deep under the snow. They must find other foods.

These pages show how the grouse are able to live through the winter.

The grouse ate some fruit from a wild rose bush.

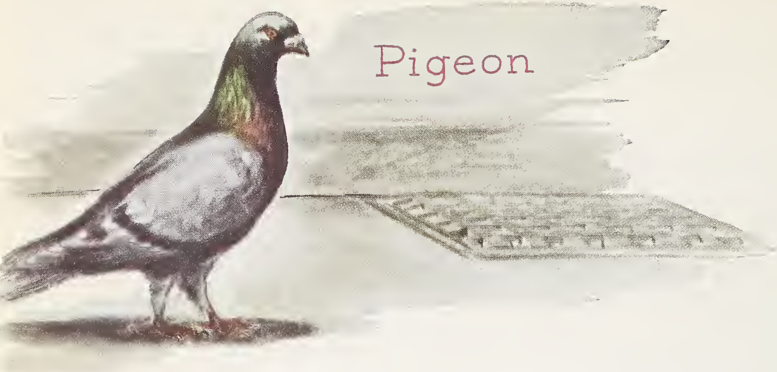


The grouse ate tree buds.

Grouse feed on fruits and berries that they find above the snow. They also eat buds from trees and bushes.

They usually sleep in evergreen trees in thick woods. If it is very cold or windy, they may sleep under the snow.

At sunset, the grouse flew headfirst into a snowbank. It spent the night there.

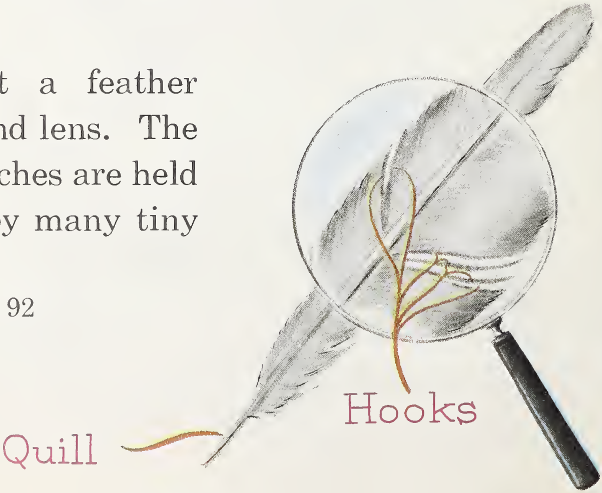


Feathers

Do you know how a bird can keep dry in the rain? Look at the feathers of a pigeon, a canary, or a hen. The feathers overlap like the shingles on a roof.

Find a feather and put a drop of water on it. The water runs off. Feathers are covered with oil. Water does not stick to oily things.

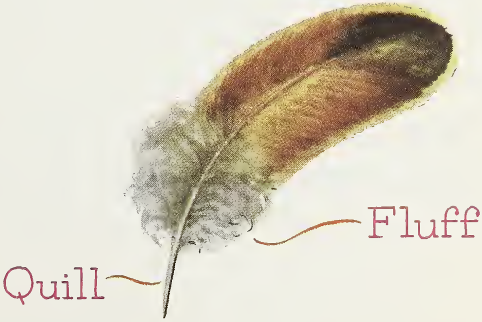
Look at a feather with a hand lens. The little branches are held together by many tiny hooks.

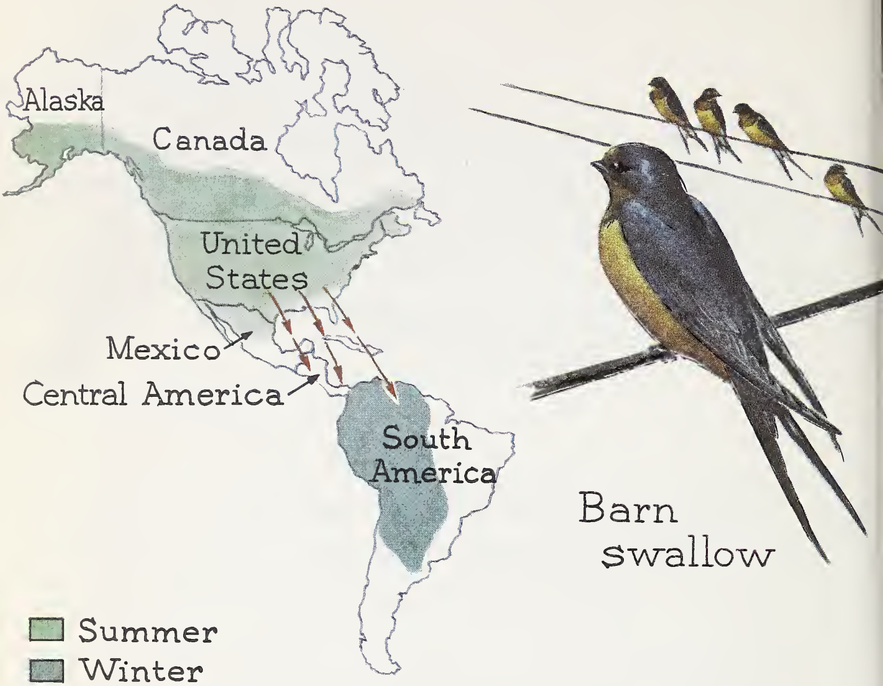


Sparrows

These birds look fat. They have fluffed out their feathers to help keep themselves warm. Feathers are warmer when they are fluffed out.

Some of the feathers on a bird have soft, fluffy parts near the bottom. This fluff helps keep a bird warm.

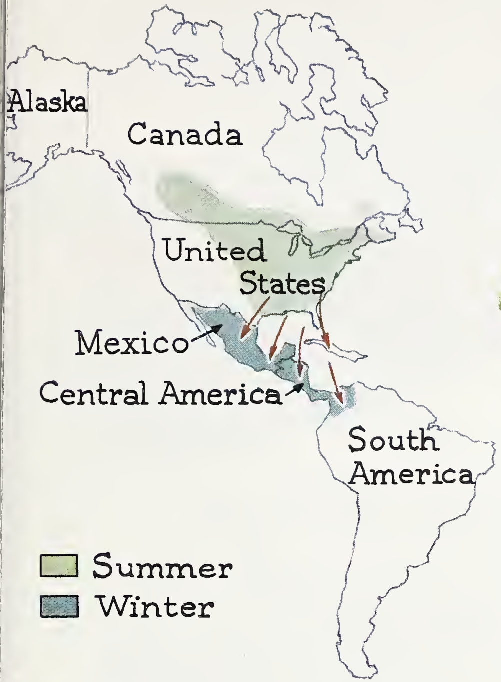




Birds That Go South in Winter

Many birds fly south in winter. Some of them go far away. No one knows how they find their way.

Barn swallows spend the winter in Central America and in South America. They come back in the spring.



Hummingbird

Hummingbirds also fly south in winter. Hummingbirds fly to Mexico and Central America.

Name some other birds which you see in summer but which you do not see in winter. Find out where these birds spend the winter.

These are wild geese flying south.

Find out where they live in the summer and where they live in the winter.

---

1. What are some foods that birds may find in the summer but not in the winter?
2. What do woodpeckers, chickadees, and nuthatches find to eat in winter?
3. What do crows find to eat in winter?
4. What is the shape of a sparrow's bill?
5. What can you do to bring birds to your yard in winter?
6. Do you see as many birds in winter as in summer? Why?

Water in Plants

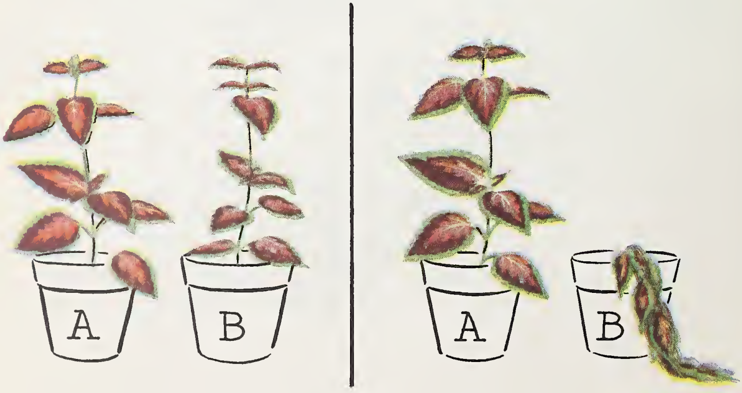
Plants Need Water

Everyone who has house plants knows that the plants need water. Some house plants must be watered every day.

This experiment shows what happens to plants that do not have enough water.

Use two plants that are about the same size. Water one plant every day for a week. Do not water the other plant. What happens?

Now water the second plant. What happens to it?



In some parts of the country there is not enough rain for growing crops. Dams may be built across rivers to make lakes. Water runs from the lakes through ditches to fields. There the water goes into the soil and helps the plants grow.

Water Plants

Some plants need much water. Some of them must have their roots in water. Others will grow only under water.

Visit a stream or a pond and collect some water plants. You can keep some of them in an aquarium.

How many water plants do you know by name?

Eel grass

Water weed

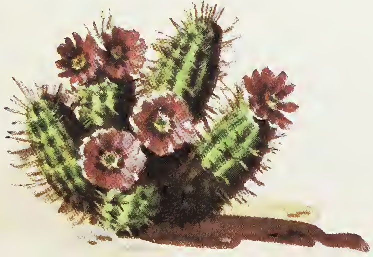
Cabomba

Desert Plants

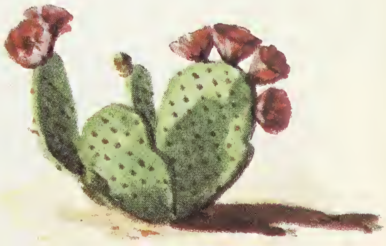
Deserts are hot and dry most of the time, but at certain times of the year it rains.

Desert plants need less water than other plants but they always need some water. They grow fastest during the short rainy season. During very dry seasons they grow very little. When do you think they blossom?

Perhaps you can buy a few desert plants and keep them in your classroom.



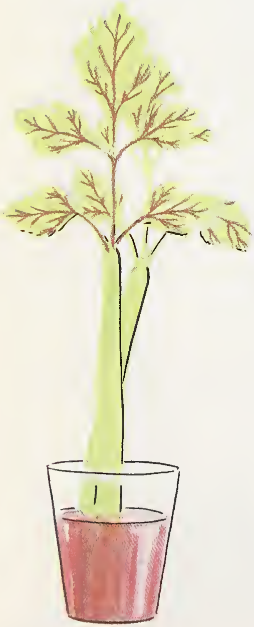
Hedgehog cactus



Beavertail cactus

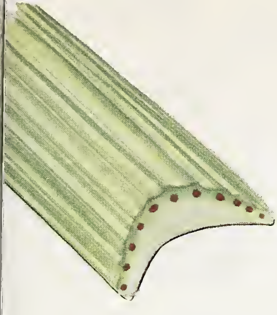
Paths of Water in Plants

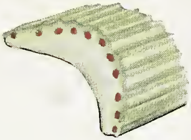
This experiment will show you where some of the water in a plant goes.

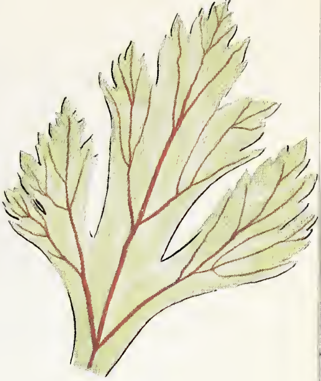


Put a stalk of white celery in a glass of water. Add a little red ink. Watch it for a few hours.

You will see the celery begin to change colour. Where did the ink go?



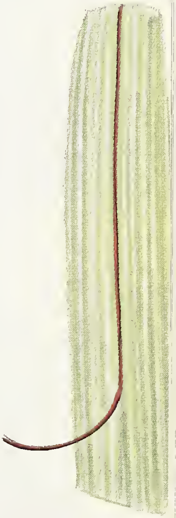


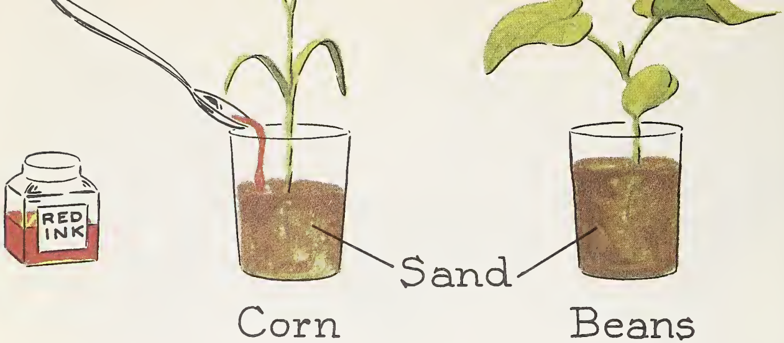


Look closely at the leaf. You will see many red lines. These lines show the paths where water rises in the leaf.

Cut off a piece of the celery stalk. Red spots show where water goes up the stalk.

Break open the stalk along one of the red lines. You can pull out one of the parts that carries water upward. Can you find one of these parts in a celery stalk that has not been in red ink?





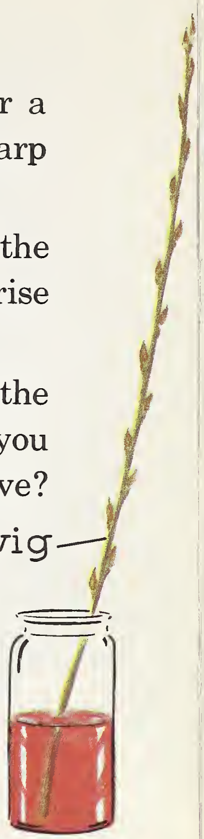
Plant some corn and beans in wet sand. Keep the plants in a dark place so that they are yellow. After both plants have leaves, put some red ink in the sand. Find the paths through which water rises in these plants.

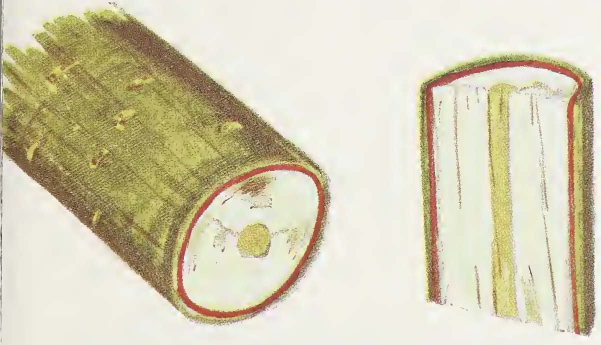
Put some white carnations in ink of different colours. What will happen?

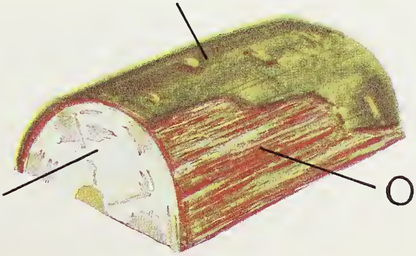
Put a willow twig in red ink. After a day or so, cut the twig open with a sharp knife.

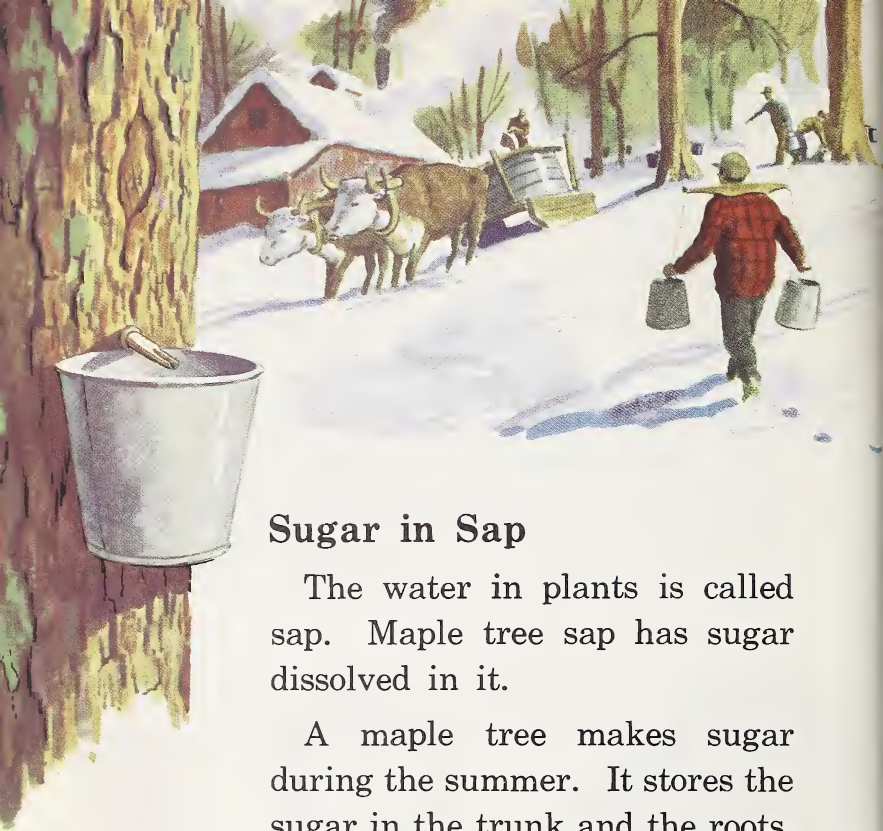
The ink rises in the outer part of the wood, just inside the bark. It does not rise through the bark.

In the same way, water rises through the outer part of the wood in trees. Can you explain why a hollow tree can stay alive?





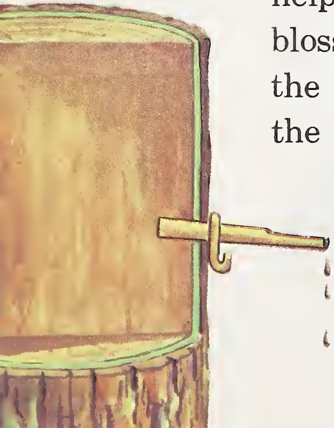


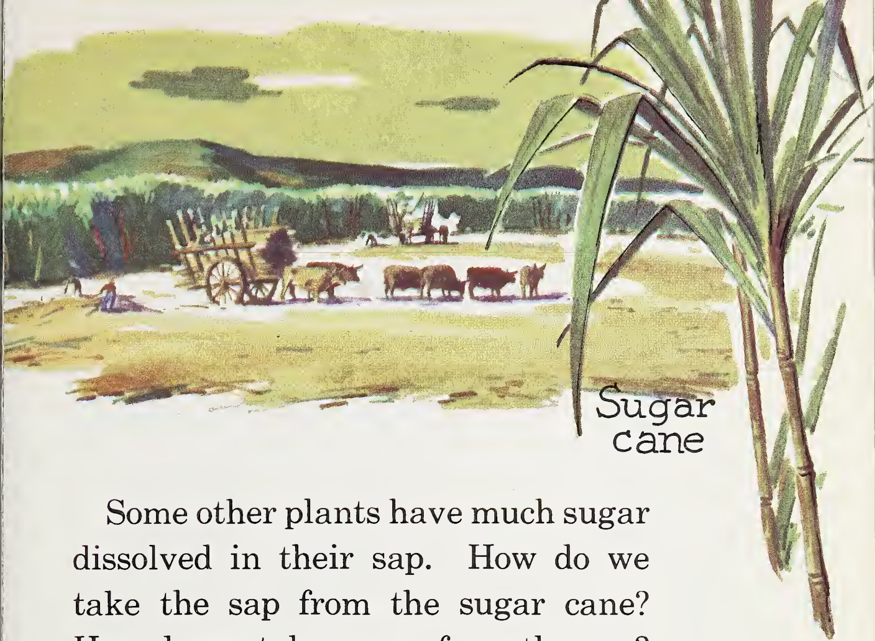


Sugar in Sap

The water in plants is called sap. Maple tree sap has sugar dissolved in it.

A maple tree makes sugar during the summer. It stores the sugar in the trunk and the roots. In spring the sugar is used to help form new leaves and blossoms. We take a little of the sap as it rises to the tops of the trees.

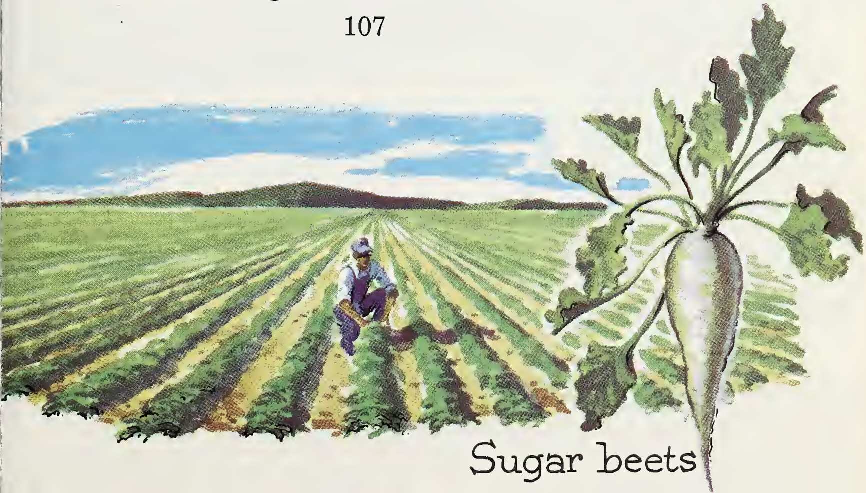




Sugar cane

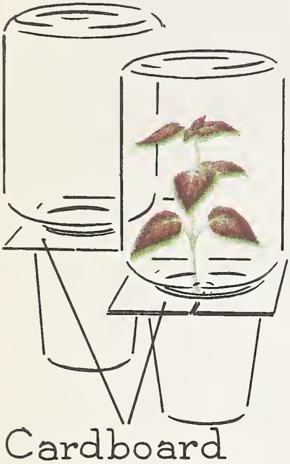
Some other plants have much sugar dissolved in their sap. How do we take the sap from the sugar cane? How do we take sugar from the sap? Find out how the plants grow.

Find out how we make sugar from sugar beets. Find out how sugar cane and sugar beets are raised.



Sugar beets

Water from Plant Leaves

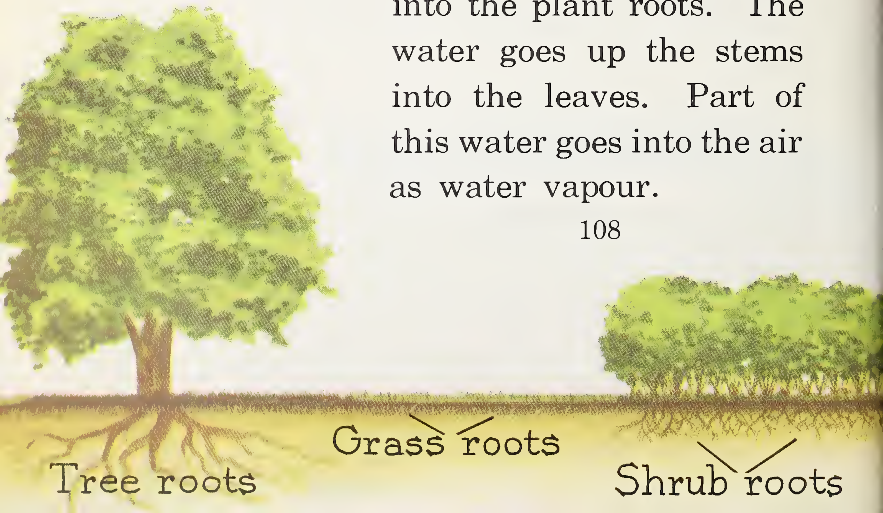


This experiment shows what happens to much of the water that goes into the leaves of plants.

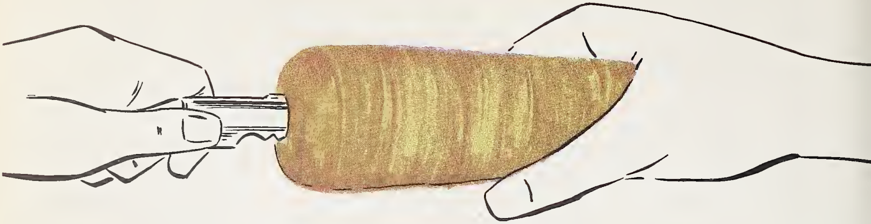
Put cardboard over the soil in two plant pots. Only one pot has a plant in it.

Put a glass jar over each pot. Look at the jars the next day. What happened? Can you tell why?

Water in the soil goes into the plant roots. The water goes up the stems into the leaves. Part of this water goes into the air as water vapour.



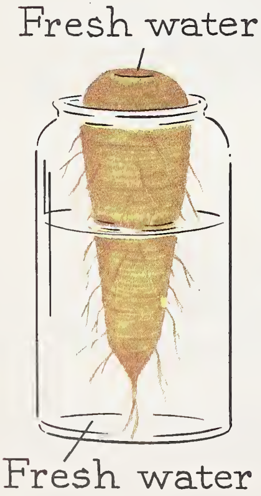
Water goes up the trunks to the tops of these giant trees. Then some of the water goes into the air from the leaves.

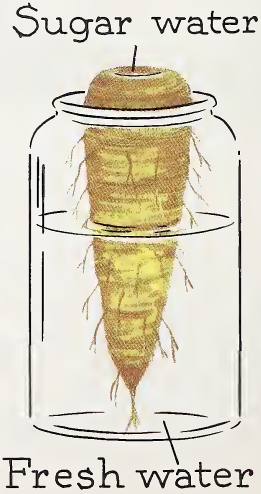


How Water Goes into Roots

Bore a hole in the tops of two carrots. Put a little sugar water in the hole in one carrot. Put the same amount of fresh water in the other carrot.

Set each carrot in a jar of fresh water. After a few hours look at the carrots. Which carrot now has the most water inside? Where did it come from?





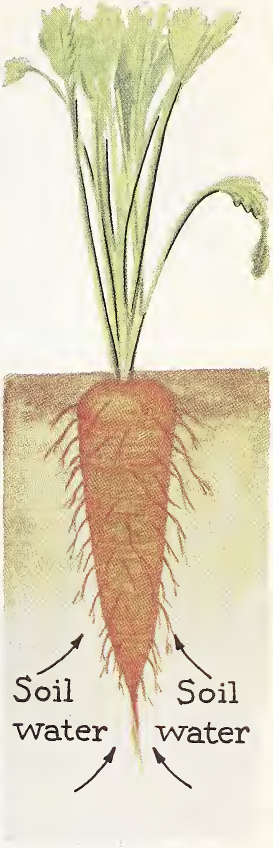
The sap of plants usually has sugar dissolved in it.

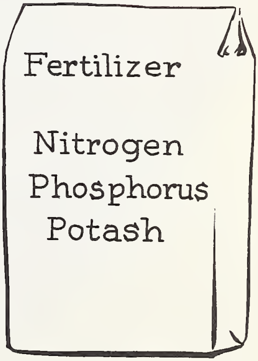
Water in the soil goes into the roots of the plant toward the sugar water, much as it did in your experiment.

Some of the minerals in the soil dissolve in the soil water. Then they are carried into the roots of the plants.

Plants use some of the minerals in the soil water when they make food for themselves.

Sometimes there are not enough of these minerals in the soil and the plants do not grow well. We can add more of these minerals by putting fertilizer on the soil.





Animals and Sap

This bird is called a "sap-sucker." It makes holes in the bark of trees and drinks the sap.

Some insects drink sap. A "spittle bug" uses sap for food. It also uses it for bubbles. How do these bubbles protect a spittle bug?

---

1. What is dissolved in the sap of plants?
2. In what part of a tree does sap rise?
3. How does water get into most plants?
4. Name a plant that needs much water. Name a plant that needs little water.
5. Where does sap rise in a celery leaf?
6. How does fertilizer get into plants?

Static Electricity

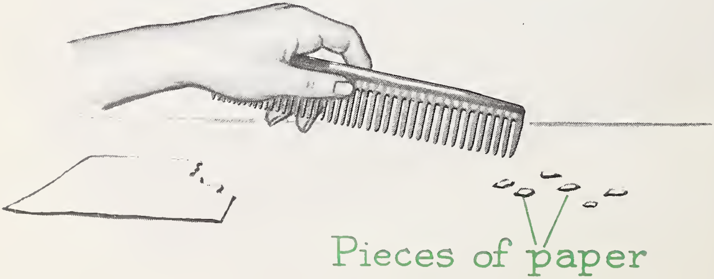
Making Electric Charges

Here are some experiments with electricity that you can do. You will find that they work best on cold, dry days in winter.

Rub a comb rapidly with a wool cloth. Hold the comb near bits of thin paper. What happens?

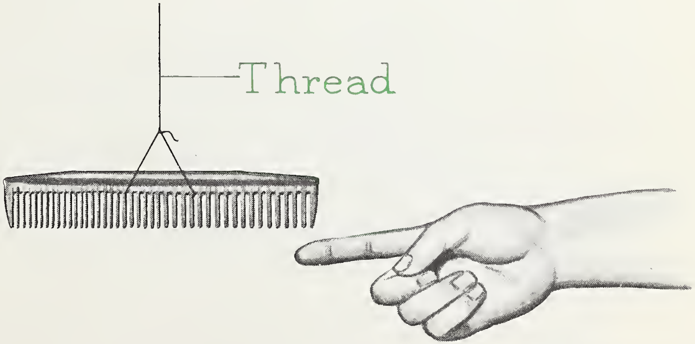
Hold a comb near other things, such as hair, bits of thread, and pencil shavings. What happens each time?

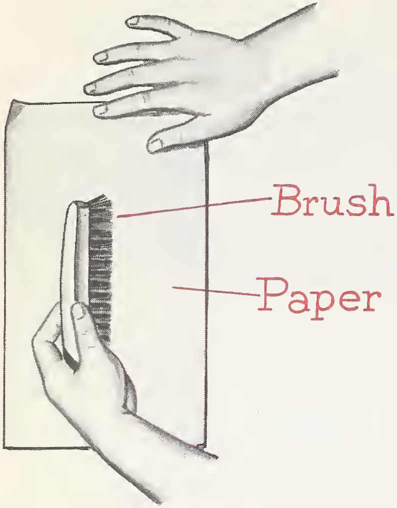
Will a magnet pick up these things? Try it and see. What will a magnet pick up?



Hold a comb that has not been rubbed near a floating bathtub toy. What happens? Rub the comb with a wool cloth and hold it near the toy. Watch the toy move across the water.

Hang a comb by a thread as shown below. Hold your finger near the comb. What happens? Rub the comb with a wool cloth and hold your finger near it. Watch the comb move.

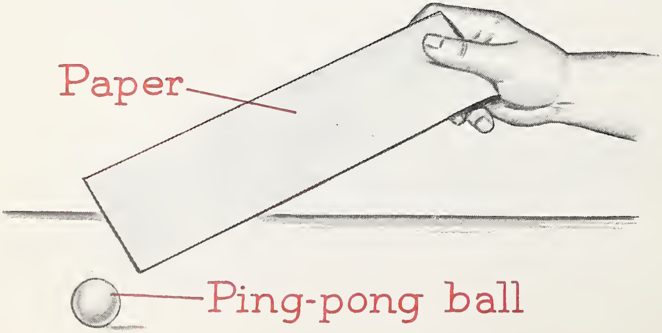


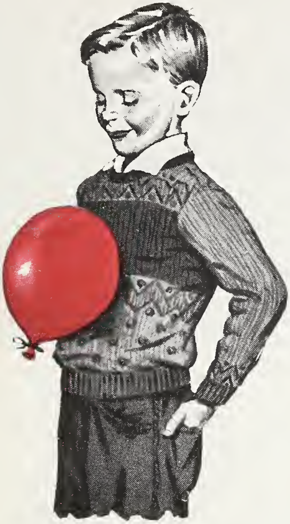


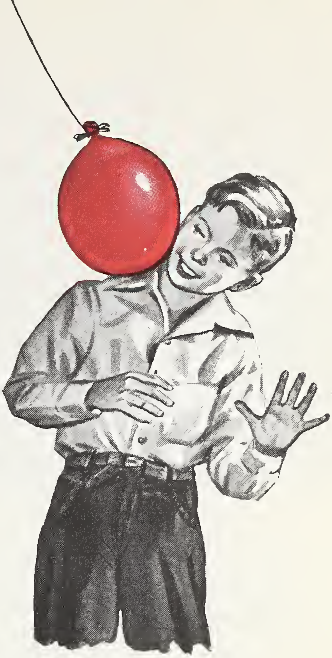
Hold a sheet of paper against the blackboard and rub it rapidly with a brush. Take your hands away. What happens?

Rub a sheet of paper with a brush. Hold one corner of the paper near a Ping-pong ball. What happens?

Now try these experiments without rubbing the paper. Must you rub the paper to make it do these things?



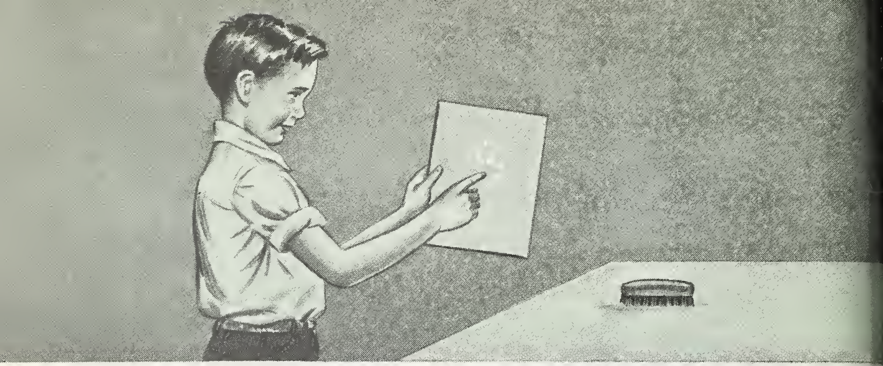




Rub a balloon with a wool cloth. Hold the balloon near your body. What happens?

Hang the balloon by a thread. Rub the balloon with wool and walk near it. What happens?

Rubbing the balloon gives it energy. Because it has energy, it is able to move. We call this kind of energy electrical energy. We say that something with electrical energy is charged with electricity.



Electric Sparks

You will need a darkened room for this experiment. Perhaps you can do the experiment at home after supper.

Rub a sheet of paper with a brush. Then hold it in front of you and move one finger across it. Can you see little flashes of light? These are electric sparks. Can you hear anything?

Comb your friend's hair in the dark or rub your cat's fur in the dark. Can you see sparks? Can you hear these sparks snapping?

Lightning is a big electric spark. Sometimes the tiny drops of water in clouds become charged with electricity. The charges may be strong enough to jump to other clouds or to the ground. This makes an electric spark we call lightning.

In your experiment in the dark, you saw little flashes of light. You heard faint noises, too. The electric charges in clouds have much more energy than the charges you gave the paper. The sparks are much bigger and brighter, and the noises they make are much louder. What do we call the noise that lightning makes?

Safety from Lightning

Not many people are ever hurt by lightning. We need only a few simple rules to keep us safe. We should remember that lightning follows easy paths to the ground. We should try to stay away from these paths.

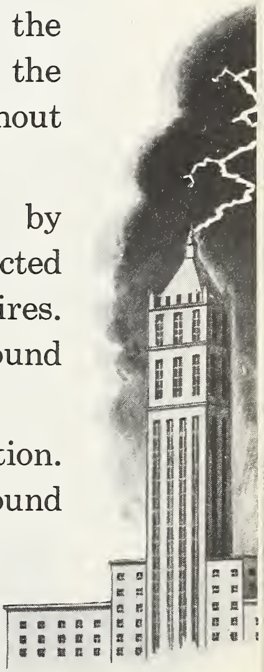
A tall tree standing alone makes a good path for lightning. You should not be under one during a thunderstorm. You should not stand in a field or on top of a hill. In a woods it is better to stay under the lower trees.

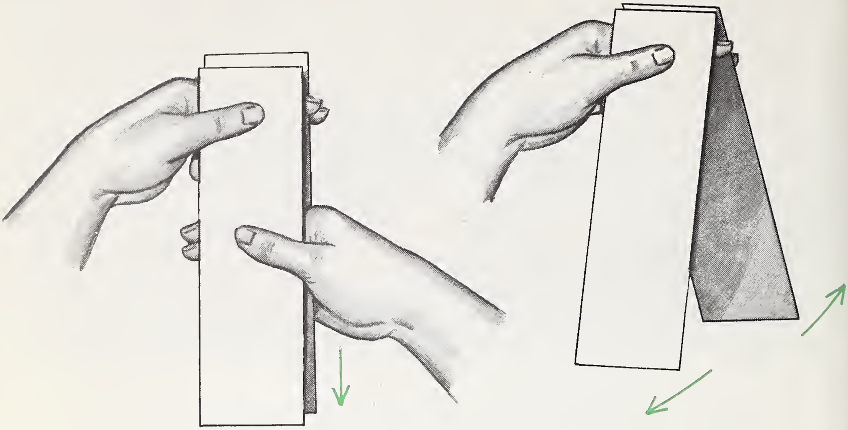
Electricity in thunder clouds has enough energy to set fire to wooden buildings. Many farm buildings burn because of lightning.

Metal roofs can be connected to the ground by wires or pipes. Then the electricity goes to the ground without doing any harm.

Buildings can be protected by lightning rods. The rods are connected to the ground by large wires. Electricity can go to the ground through the wires.

Metal buildings need no protection. The electricity goes to the ground through the metal.



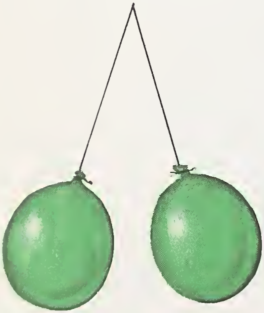


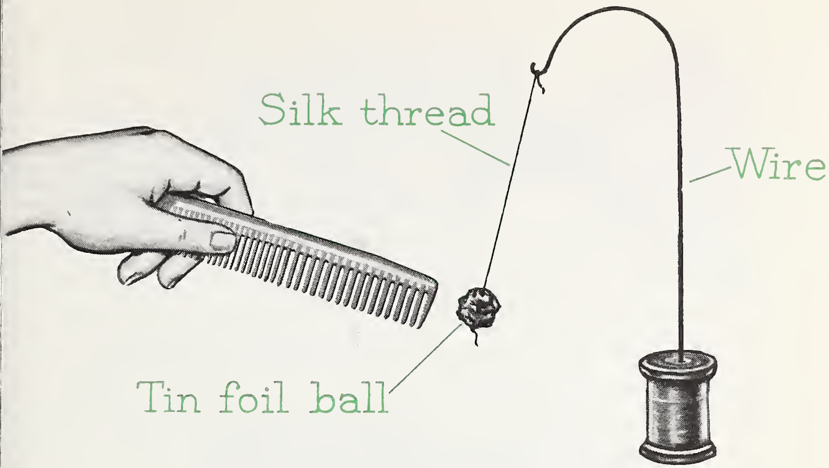
Charged Things May Push Away from Each Other

Hold two strips of paper as shown in the picture above. Rub them by pulling two ends rapidly through your fingers. Notice what happens.

You already know that when something is charged it pulls on things that are not charged. Now you see that two pieces of charged paper push each other.

Hang two balloons by threads. Rub each balloon with wool. What happens?



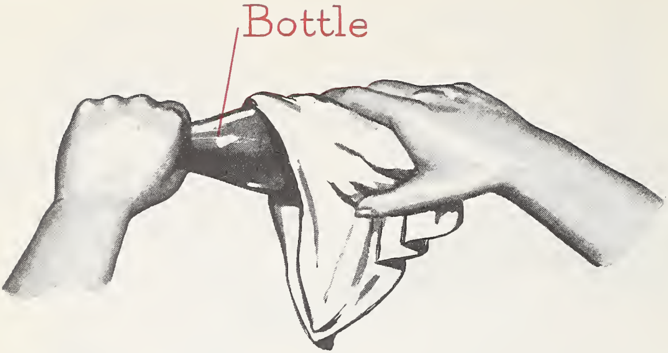


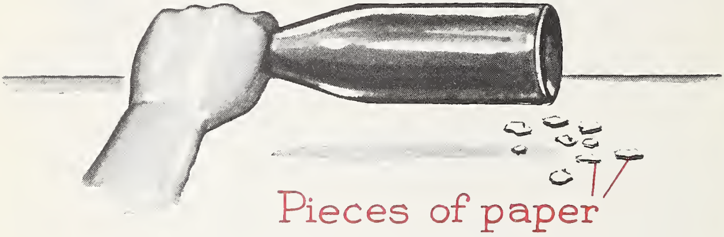
Make a little ball of tin foil. Hang it by a silk thread. Charge a comb by rubbing it with wool. Bring the comb near the ball of tin foil. What happens?

At first the ball has no charge. It is pulled by the charged comb.

When the ball touches the comb, part of the charge in the comb goes into the ball. You may hear the spark as the electricity jumps to the ball.

Now the ball has the same kind of charge as the comb. Can you explain why the ball flies away from the comb?



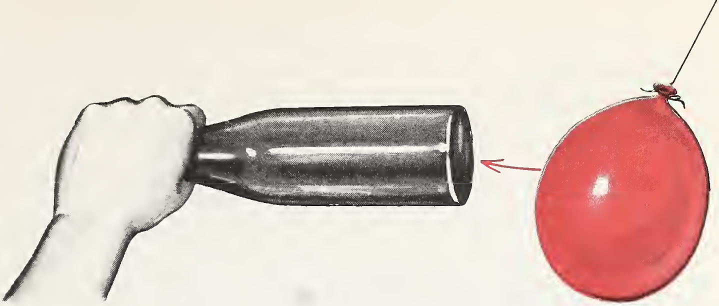


A Different Charge

Rub a glass bottle with a silk cloth. Hold the bottle near bits of thin paper. Can it pick them up?

Will the bottle pick up hair, bits of thread, and other light things?

Rubbing the bottle with silk charges it with electricity.

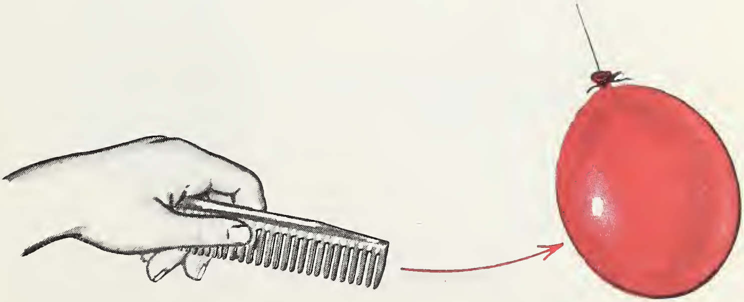


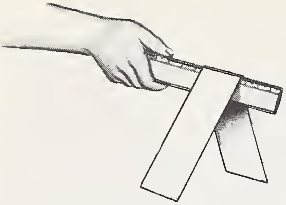
Hang a rubber balloon by a thread. Give the balloon an electric charge by rubbing it with a wool cloth.

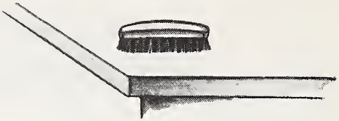
Rub a glass bottle with silk. Hold it near the balloon. What happens?

Rub a comb with wool. Hold it near the balloon. What happens?

We know that the bottle is charged because it picks up bits of paper. We know that the comb is charged. But we know that the two kinds of charges are not the same. We have found a new kind of charge.







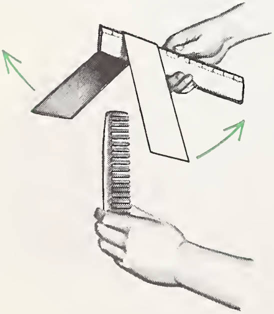
Two Kinds of Charges

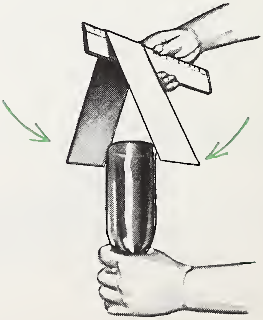
Charge a long strip of paper by laying it on a table and brushing it rapidly. Then lay the paper over a ruler as shown above.

Charge a comb by rubbing it with wool. Hold the comb beneath the paper. What happens?

Charge a bottle by rubbing it with silk. Hold the bottle beneath the paper. What happens?

The comb and the paper push each other apart. We say that they have like charges. The bottle and the paper pull each other. We say that they have unlike charges.

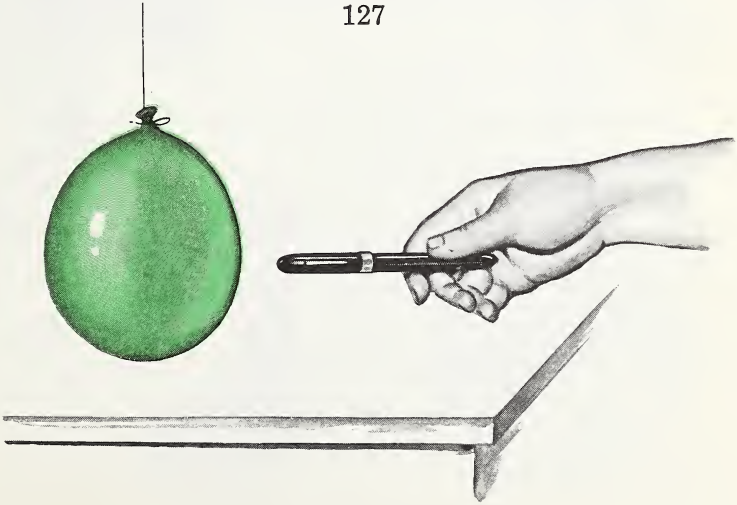


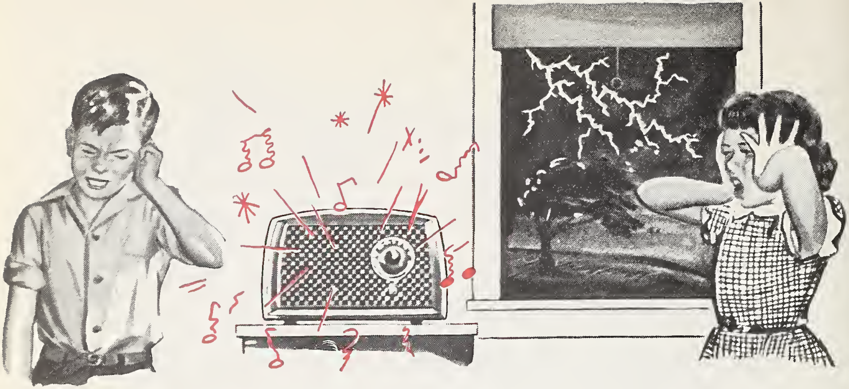


Scientists have experimented with electricity for many years. They now believe that there are only two kinds of charges.

One kind is the charge on rubber that has been rubbed with wool. The other kind is the charge on glass that has been rubbed with silk.

Rub different things with different kinds of cloth and test them. First bring each one near bits of thin paper to see if it has a charge. Then bring each one near a charged balloon. If it pushes away the balloon, it has the same kind of charge as the charge on rubber. If it pulls the balloon, it has the same kind of charge as the charge on glass.





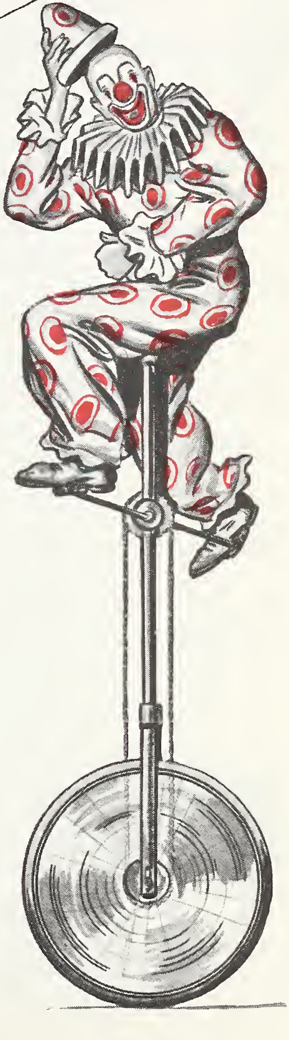
What is happening to the radio? Have you ever heard loud noises on your radio during a thunderstorm?

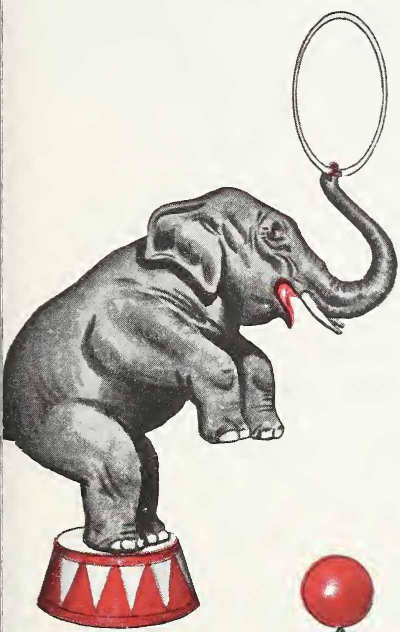
Make some electric sparks by rubbing your feet on a rug. Do the sparks make any noises on the radio?

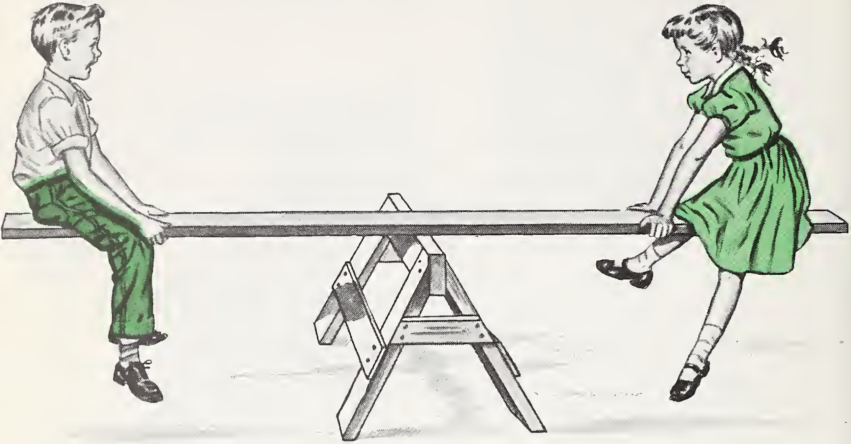
---

1. How many kinds of electric charges are there?
2. What is lightning?
3. Name some places that are dangerous during a thunderstorm.
4. What happens when things with unlike charges are brought near each other?
5. What are lightning rods?
6. How do you know that things with electric charges have energy?

Balancing Forces



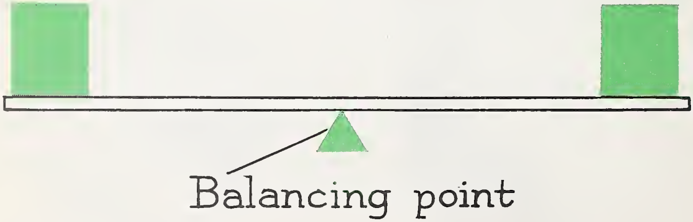


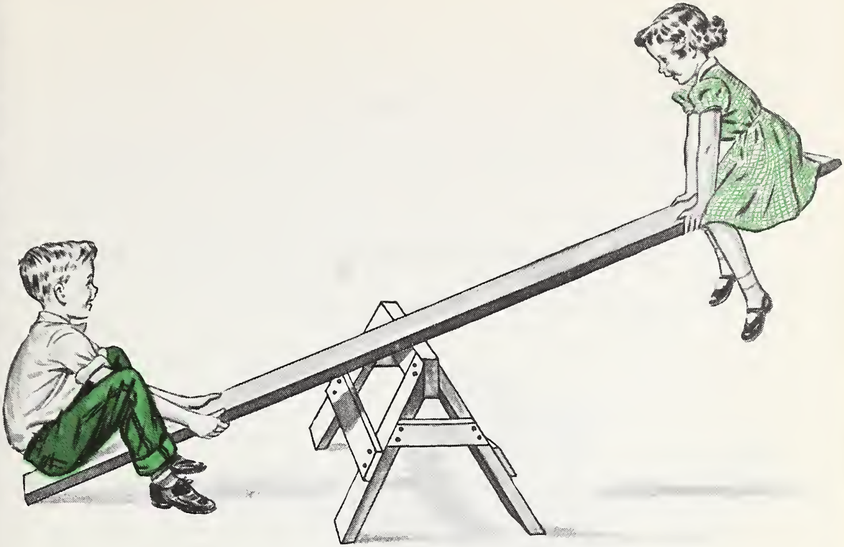


Balanced Forces

This boy weighs as much as the girl. The earth pulls down on each one with the same force. The seesaw is balanced.

Can you think of more things that are balanced?

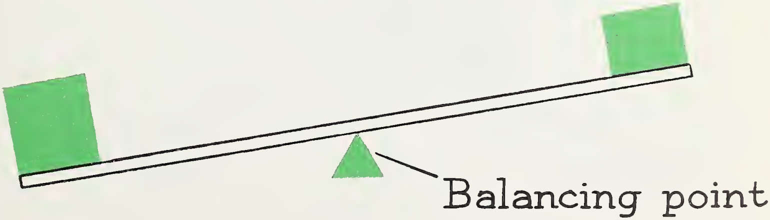




Unbalanced Forces

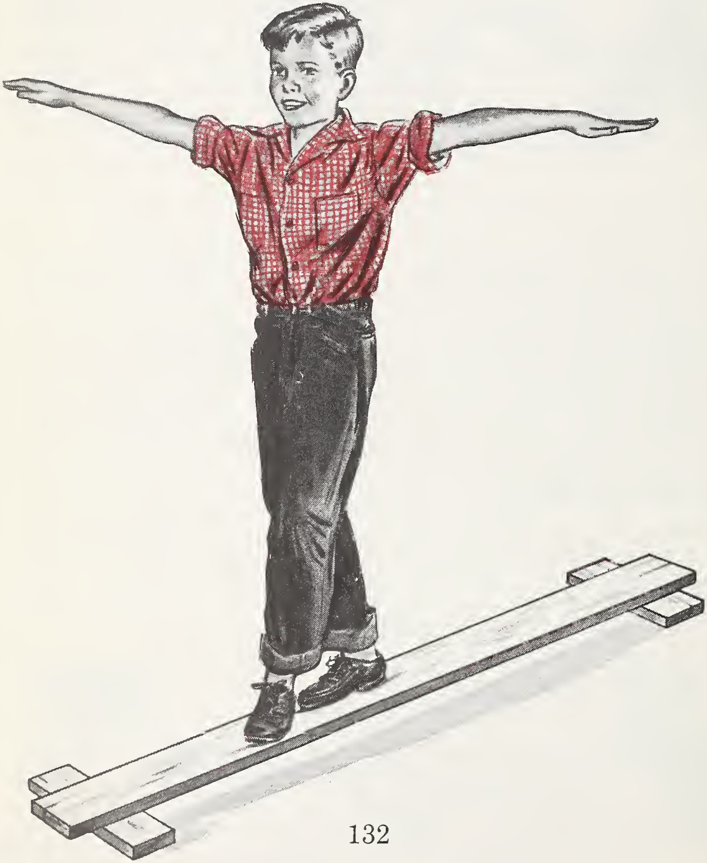
This boy weighs more than the girl. The earth pulls down more on one side than it pulls down on the other. The seesaw is unbalanced.

Can you think of other things that are unbalanced?



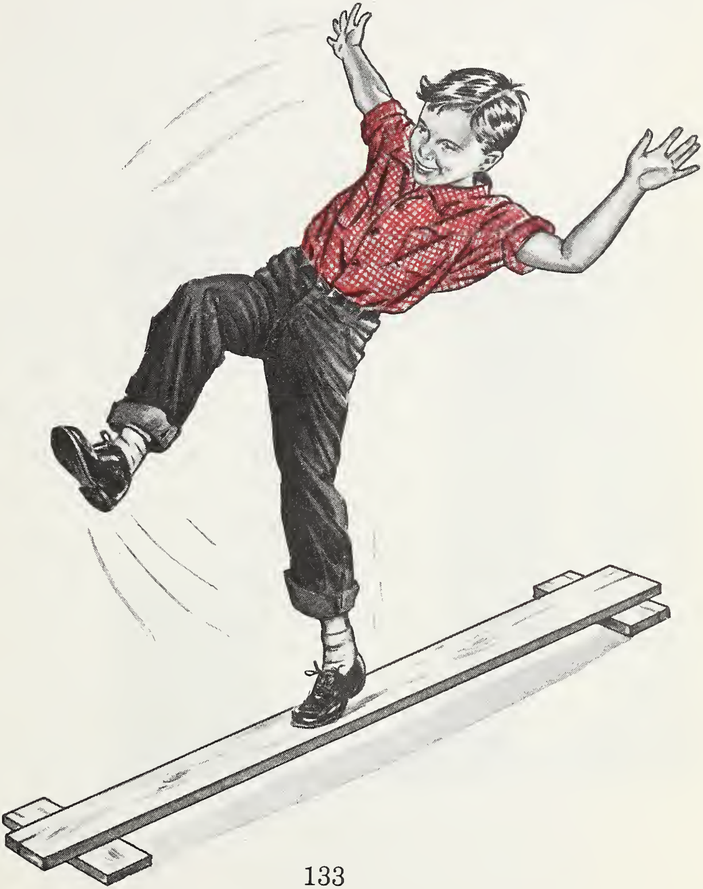
Balancing on a Board

This boy is balanced on a board. Half his weight is on one side. Half his weight is on the other side. The earth pulls down with the same force on each side.



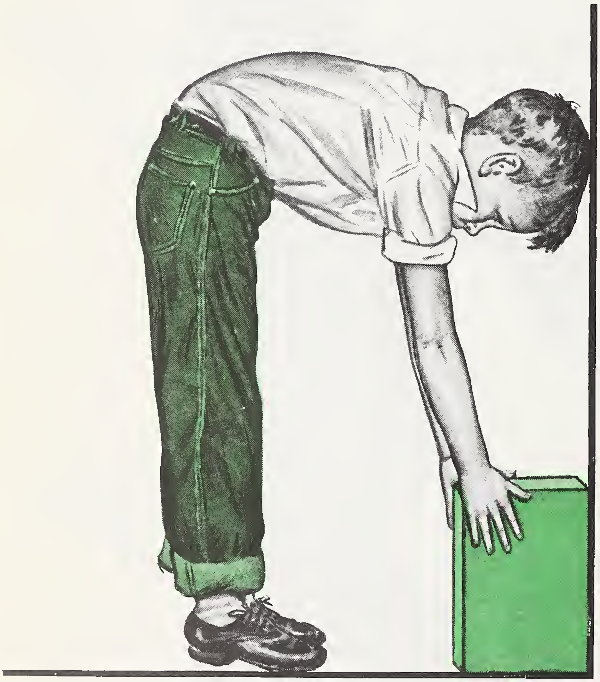
In this picture the boy put more of his weight on one side of the board than on the other.

Tell why he is tipping over.



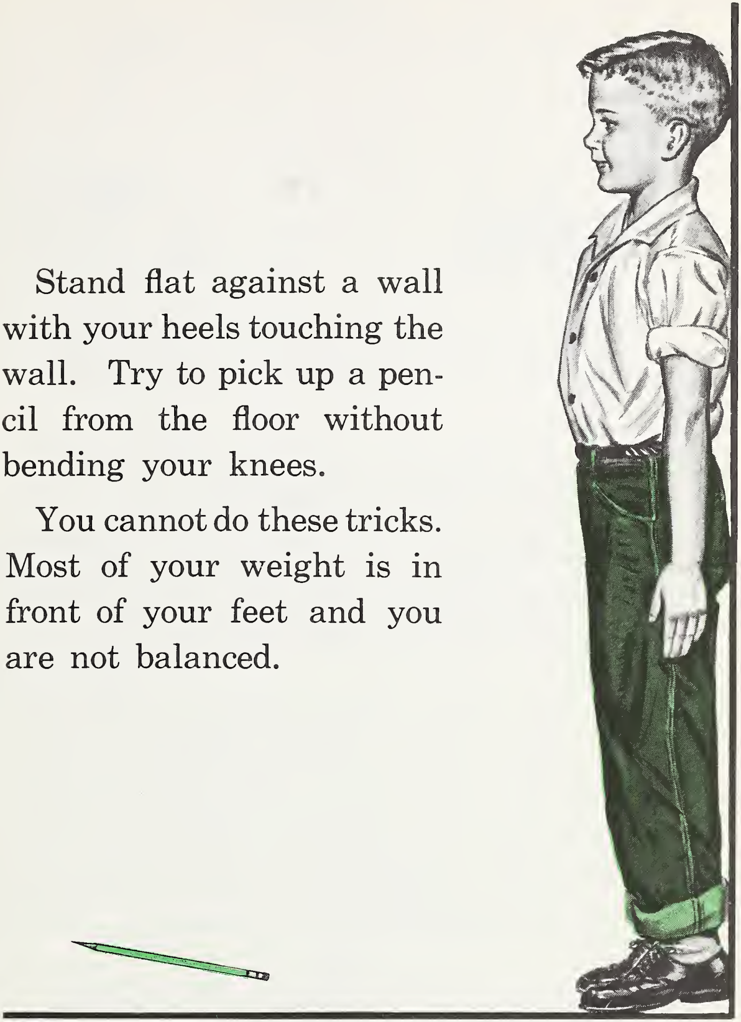
Balancing Tricks

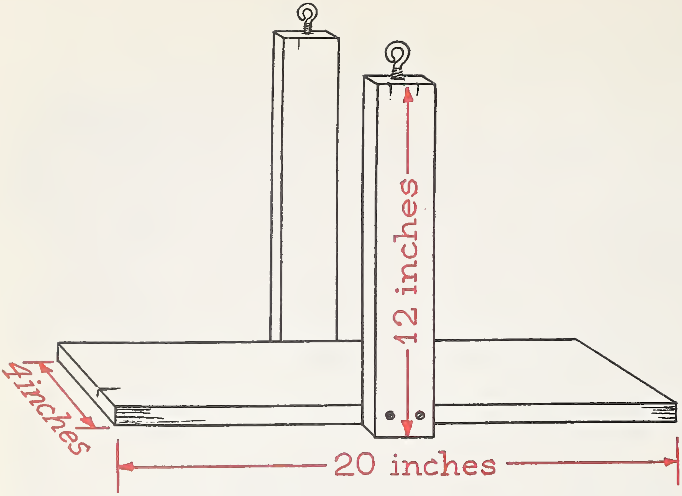
Put a small box on the floor near a wall. Stand about two feet from the wall and place your head against the wall. Without bending your knees, reach down for the box. Try to lift the box and stand up straight.



Stand flat against a wall with your heels touching the wall. Try to pick up a pencil from the floor without bending your knees.

You cannot do these tricks. Most of your weight is in front of your feet and you are not balanced.

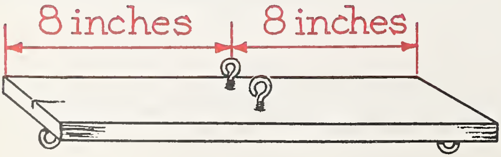


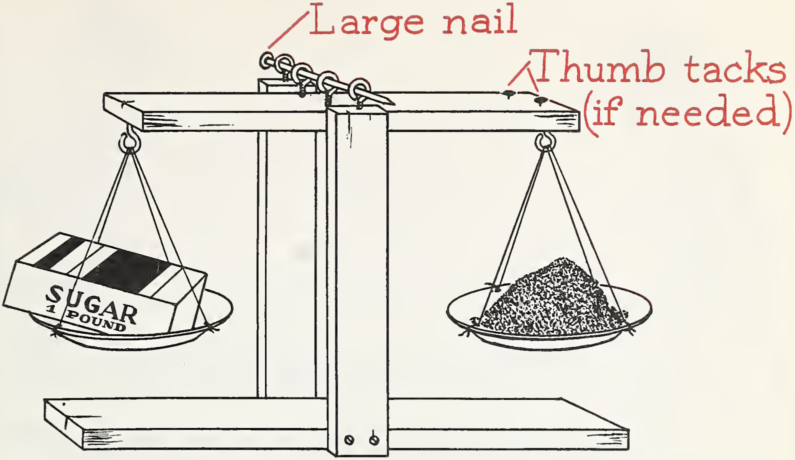


Weighing with a Balance

These pictures show how to make a balance for weighing out small things. Can you guess why it is called a balance?

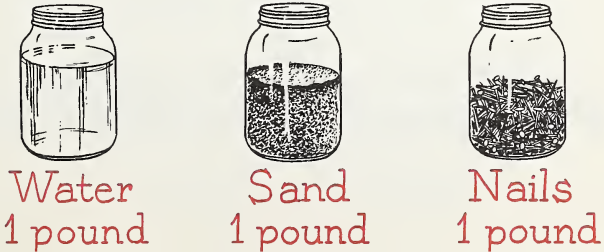
The top picture shows how to make the base. The bottom picture shows how to make the balance arm. Be sure that the two top screw eyes are in the middle. Be sure that the bottom two screw eyes are at the same distance from the middle.

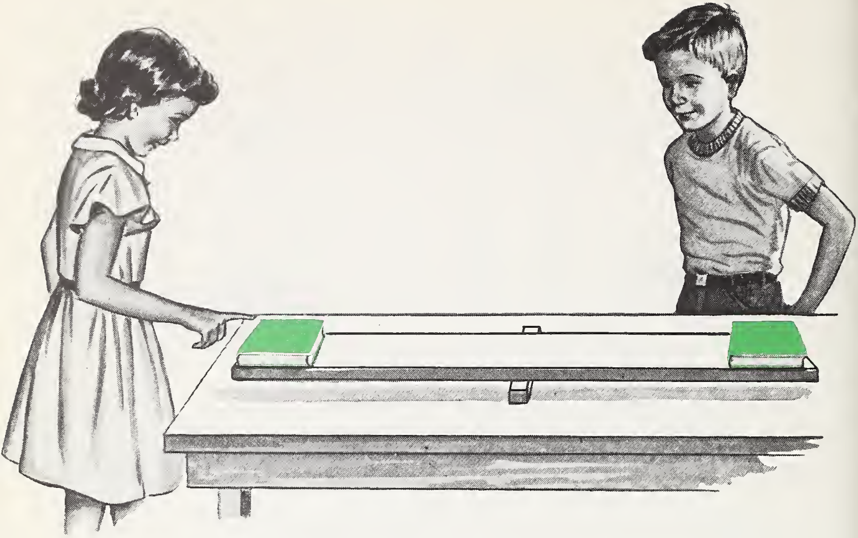




Put a long nail through the four screw eyes on the top of the balance. Hang paper plates from the screw eyes at the ends of the balance arm. If the balance arm is not level, put thumb tacks in one end until it balances.

Put a one-pound weight on one plate. Now weigh out one pound of sand. Weigh out a pound of nails. Weigh out other things. Can you think of a way to weigh out a pound of water?

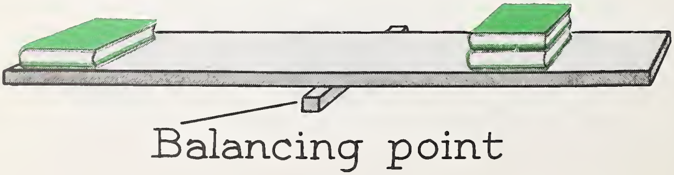


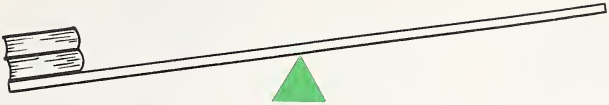


Balancing Books

Find a light board three or four feet long. Balance it on a block of wood. Put a book on each end. Try to find two books that weigh the same. Do they balance?

You can balance two books with one book by putting them on the board as shown below. Try it. What are some ways you can balance the books shown on the next page?





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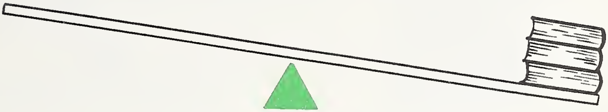

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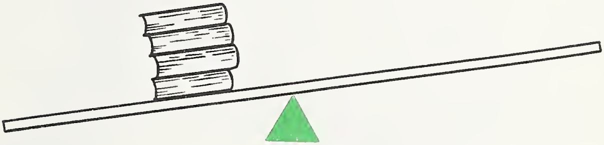

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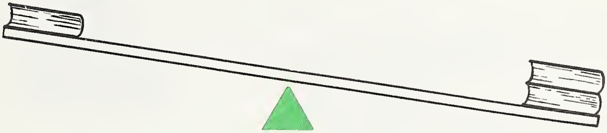

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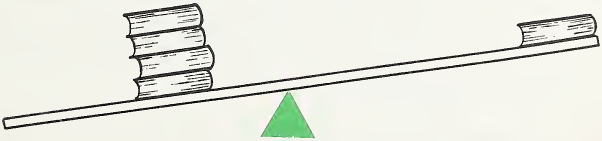

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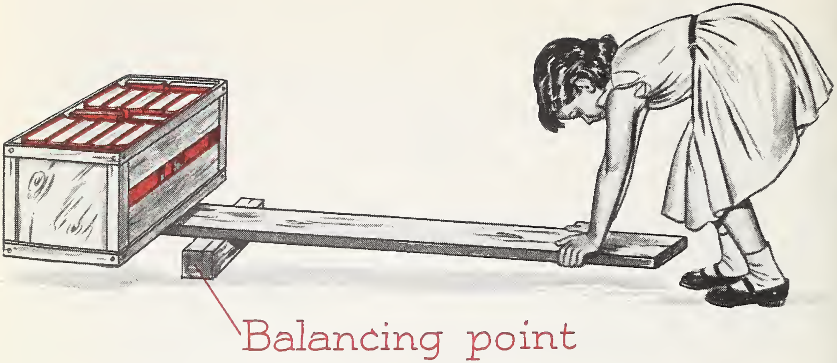
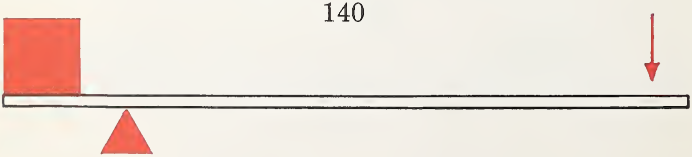


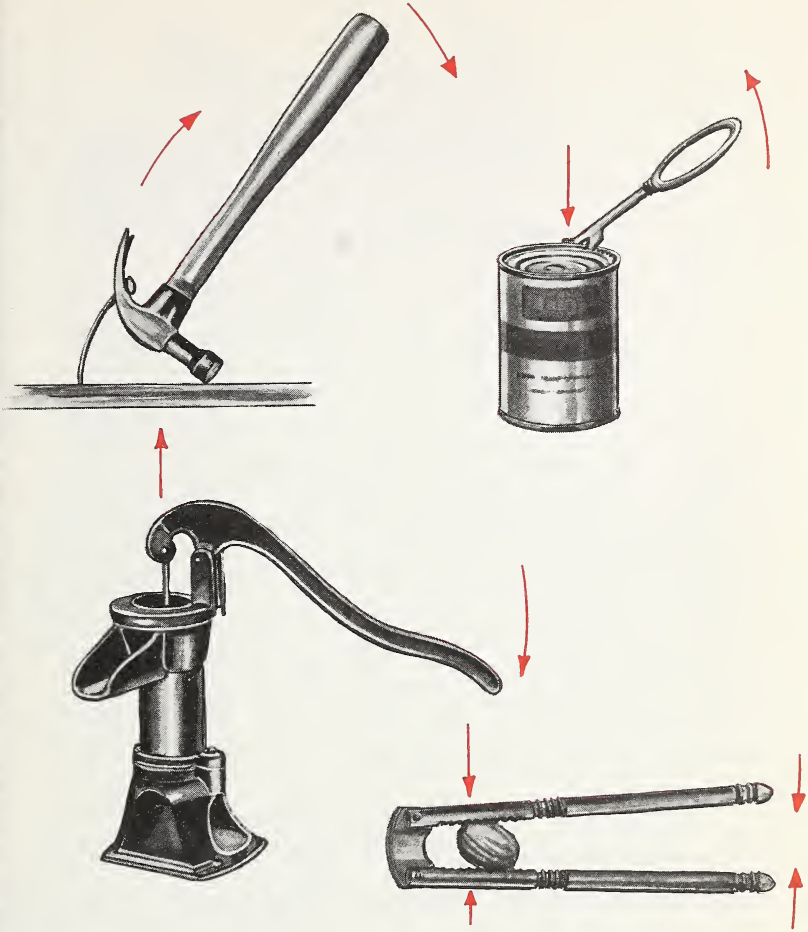
Levers

Try to raise a box of books as shown in the picture above. We call a board used like this a **lever.** Where should you put your hand to make the lifting easiest?

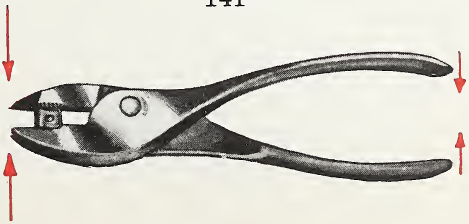
You can lift a box of books this way using less force than when lifting it with your hands alone. The farther you put your hands from the balancing point, the easier it is to raise the box.

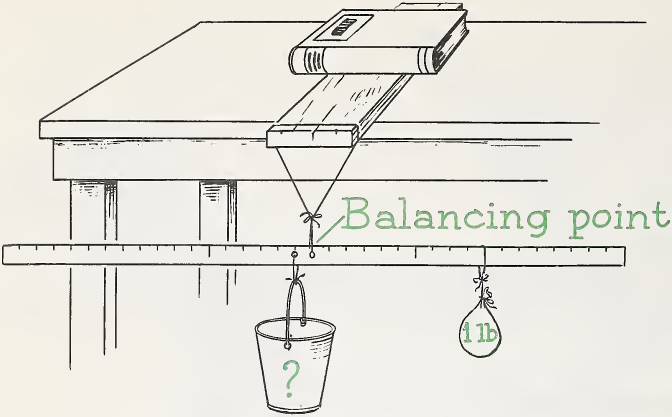
This is somewhat like the experiments with balancing books. A heavy book can be balanced by a light book that is farther from the balancing point.





Here are some other kinds of levers. How do we use them?

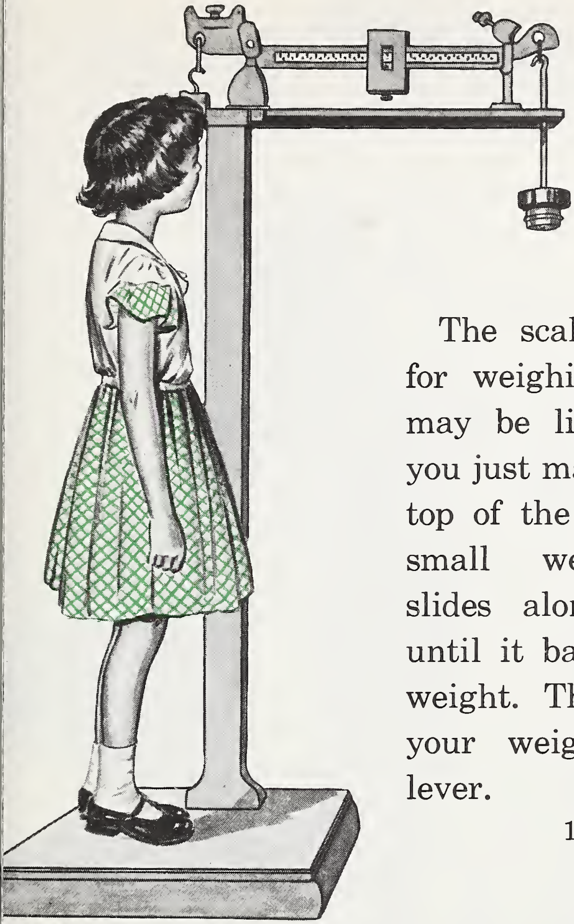




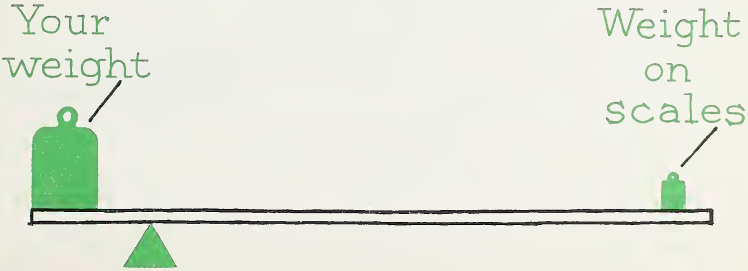
More Levers for Weighing

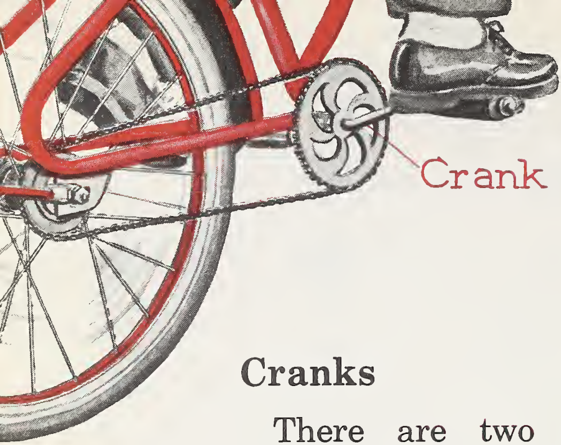
Here is another kind of weighing balance that you can make. Make a small hole at the 18-inch mark of a yardstick. Make another hole at the 17-inch mark. Run cords through the holes and fasten the balance to a table as shown in the picture.

Hang something heavy to the cord through the 17-inch hole. Slide a one-pound weight along the lever until it balances. Count the number of inches between the one-pound weight and the balancing point. This will give you the number of pounds the heavy object weighs.



The scales you use for weighing yourself may be like the one you just made. At the top of the scales is a small weight that slides along a lever until it balances your weight. Then you read your weight on the lever.





Cranks

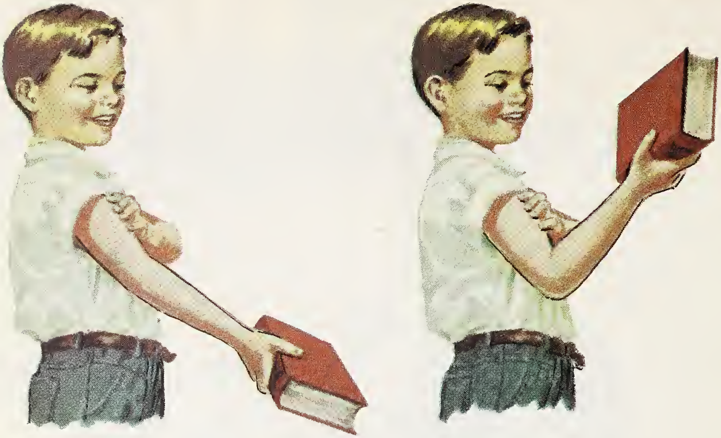
There are two cranks on a bicycle, one on each side. A crank is a lever that goes around and around.

Does a crank turn more easily if it is long or if it is short?

---

1. Why do some things tip over?
2. How can a light person balance a heavy person on a seesaw?
3. How can you use a balance to weigh things?
4. How do we use levers to help us move things?
5. When you weigh yourself, how can a small weight be made to balance your weight?

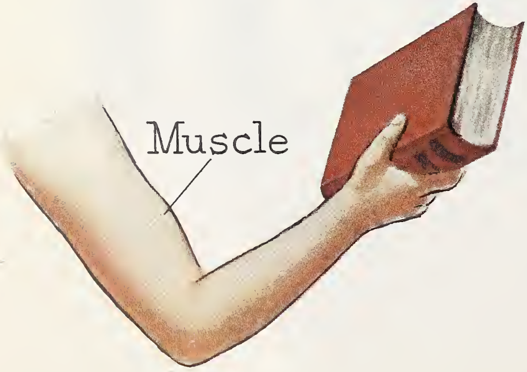
How We Move

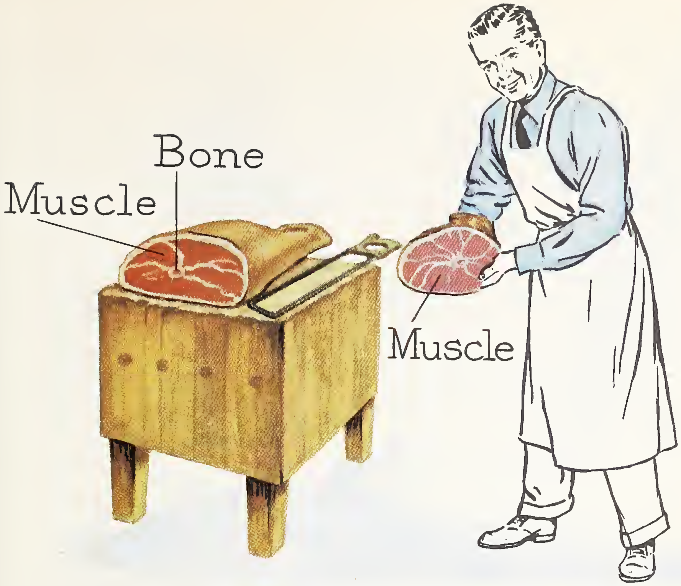


Muscles and Tendons

A part of your arm swells when you lift something heavy. The part that swells is called your muscle.

Lift a heavy book. Can you feel your muscle swell? Feel your leg muscles swell as you walk. Stand on tiptoe. Can you feel muscles in your lower legs swell?



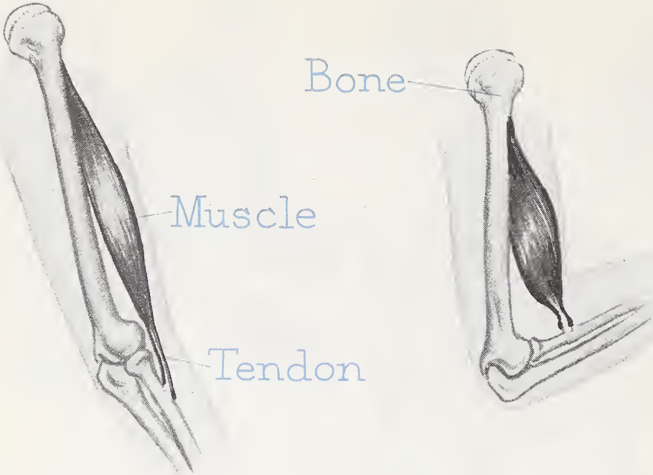


Animals have muscles too.

We eat the muscles of animals when we eat lean meat.

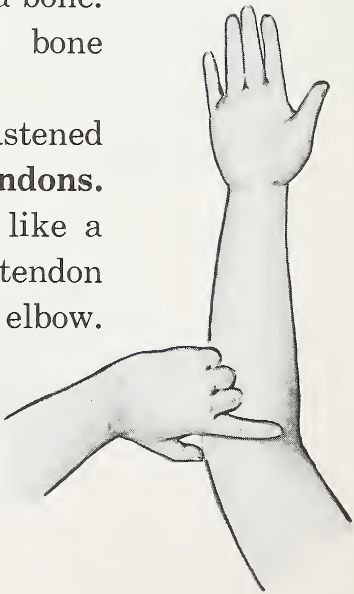
Beefsteaks are cut from the legs of cattle. A ham is the leg of a pig. A drumstick is the leg of a turkey.

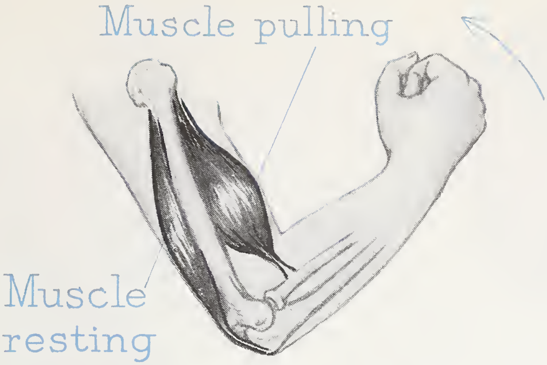
Look at some meat. Find the bone. Find the muscles.



Muscles are fastened to your bones. Whenever a muscle swells, it is pulling on a bone. The pull makes the bone move.

Some muscles are fastened to the bones with **tendons.** A tendon is something like a cord. You can feel a tendon in the hollow of your elbow.

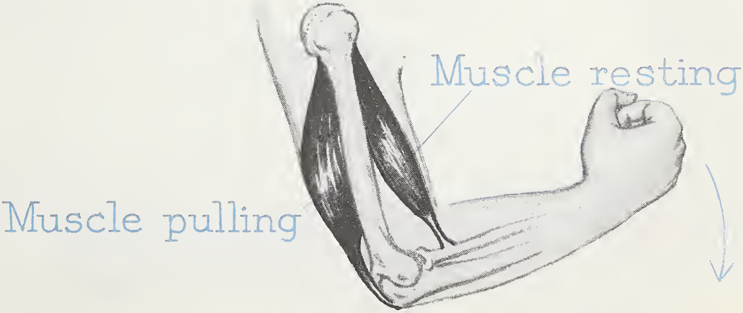


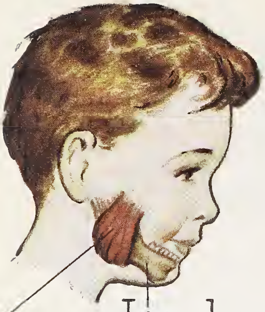


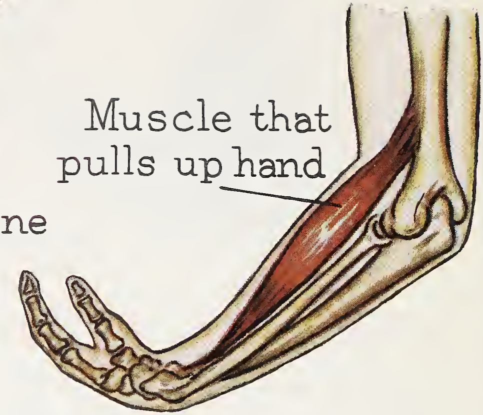
Muscles make your body move.

Look at the picture at the top of the page. Find the muscle that pulls the lower arm upward.

There is another muscle that pulls the lower arm down. You can feel this muscle in the back of your upper arm. Press the back of your hand against a table top while you feel this muscle.

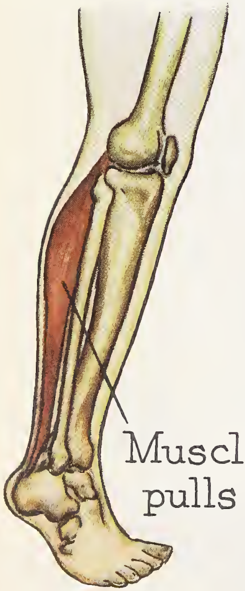






Here are more muscles for you to study. Can you find each one in your own body? Can you find what each muscle moves?

Can you find other muscles in your body? Can you find what part of your body each muscle moves?



Wrist tendons

Neck tendon

Can you find these tendons in your own body? Try to find out what each tendon moves. Can you find the muscles that pull on the tendons?

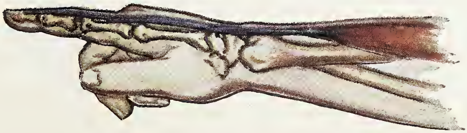
The tendons that move your fingers are long. They are connected with the muscles in your lower arms.

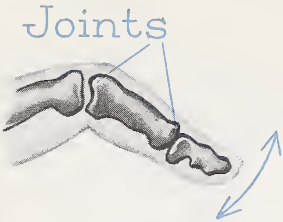
There are tendons that bend the fingers and there are also tendons that straighten your fingers. Can you find them?

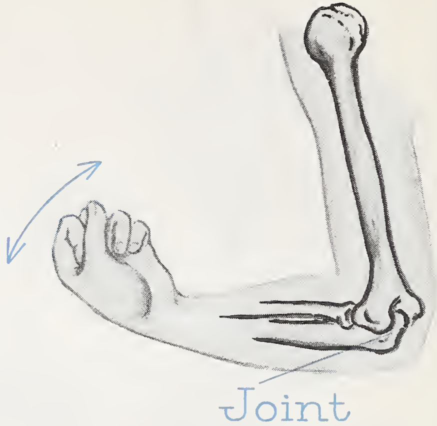
Knee tendons

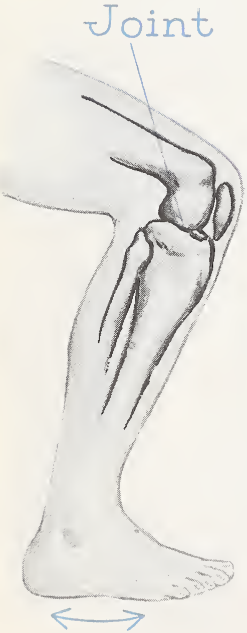
Heel tendon

Hand tendon







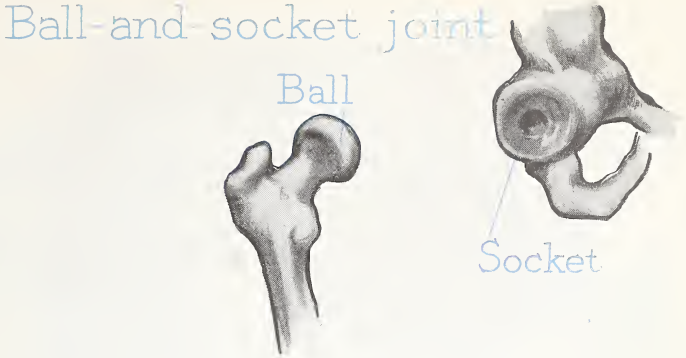


Joints

The places where parts of our bodies bend are called **joints.**

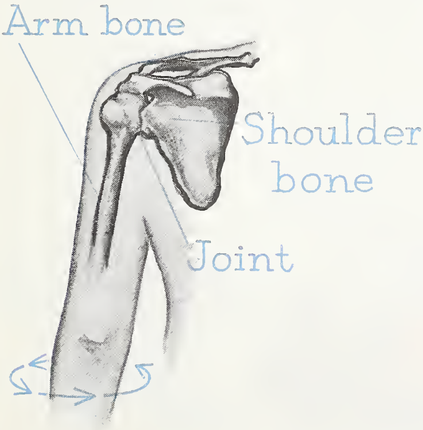
Some of the joints bend like hinges. These pictures show some of the hinge joints in your body. Find each one and see how it bends.

Can you find other hinge joints in your body?



There is a different kind of joint in the shoulders and hips. There is a ball on one bone that fits into a hollow in another bone. The hollow is called a socket.

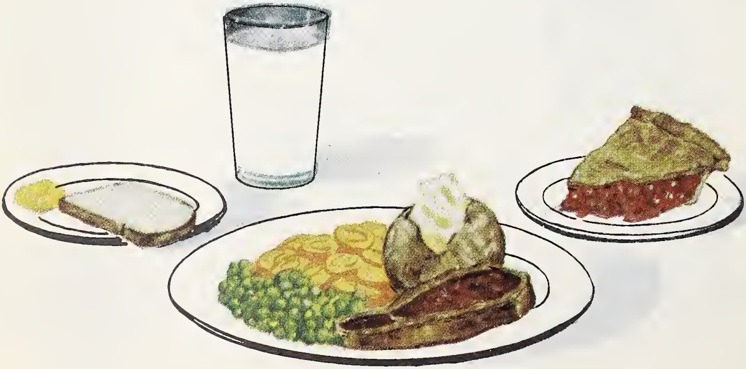
A ball-and-socket joint lets an arm or a leg swing in circles. Show how you can swing an arm or a leg in circles.

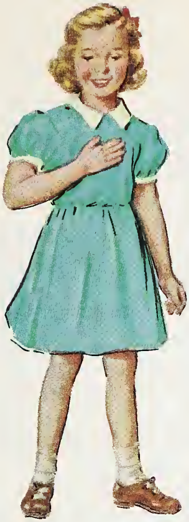


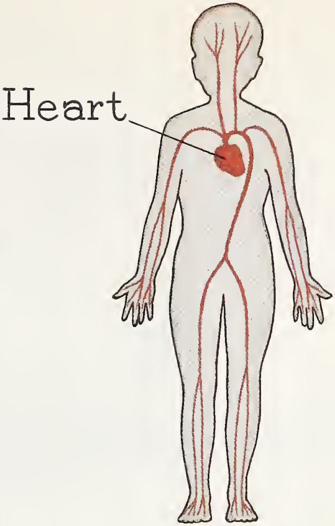
Energy for Muscles

This boy is using his muscles as he rides his bicycle. He needs energy to move the bicycle. His muscles must have energy.

His energy comes from his food. The food he eats dissolves and goes into his blood.

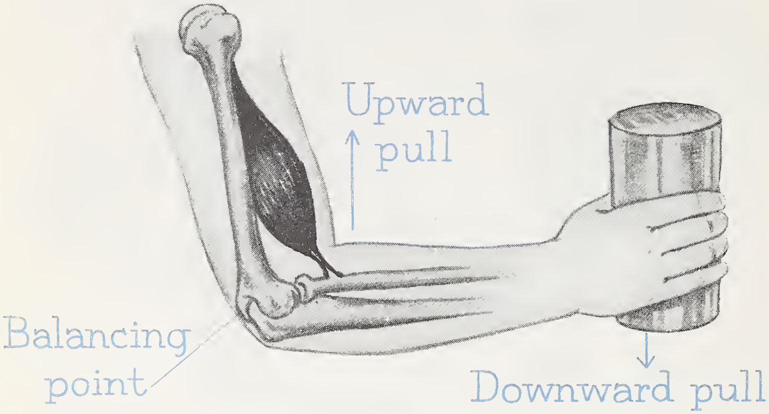






Blood carries the dissolved food to the muscles. The food gives the muscles the energy they need to move. Put your hand on your chest. You can feel your heart pumping blood through your body.

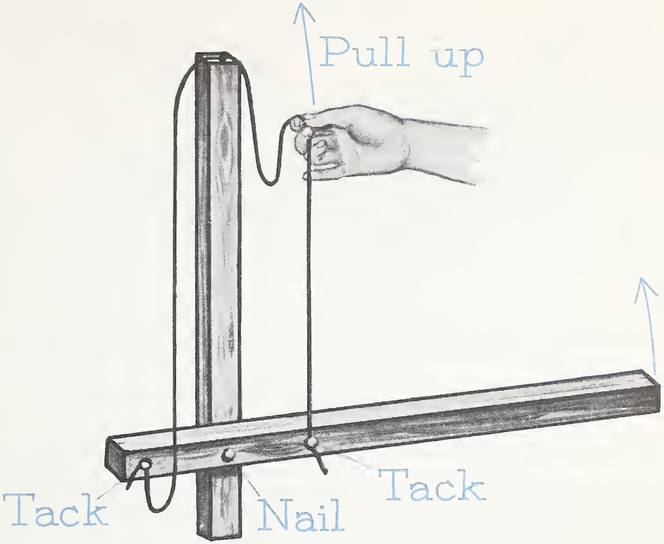
When you are exercising, you need more energy. Your heart beats faster and your blood carries more food to your muscles.



Levers in Our Bodies

Your arm is a lever. Hold something in your hand and lift it. The muscle in your upper arm pulls up on the bone in your lower arm. Your lower arm turns on the hinge joint in your elbow. Your elbow joint is the balancing point of the lever.

There are many other levers in your body. Find some of them and find the balancing points.

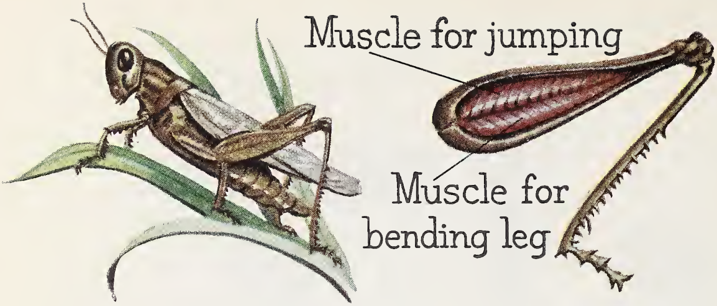


Here is a model that will show you how the lever in your arm works.

Nail two sticks together as shown. One stick will be the upper arm bone. The other stick will be one of the lower arm bones. The nail will be the elbow joint.

Fasten two strings to the lower stick with thumbtacks. These strings will be the muscles in the upper arm.

Pull one of the strings. What happens? Pull the other string. What happens?



Some animals have muscles but no bones. A grasshopper is one of these animals.

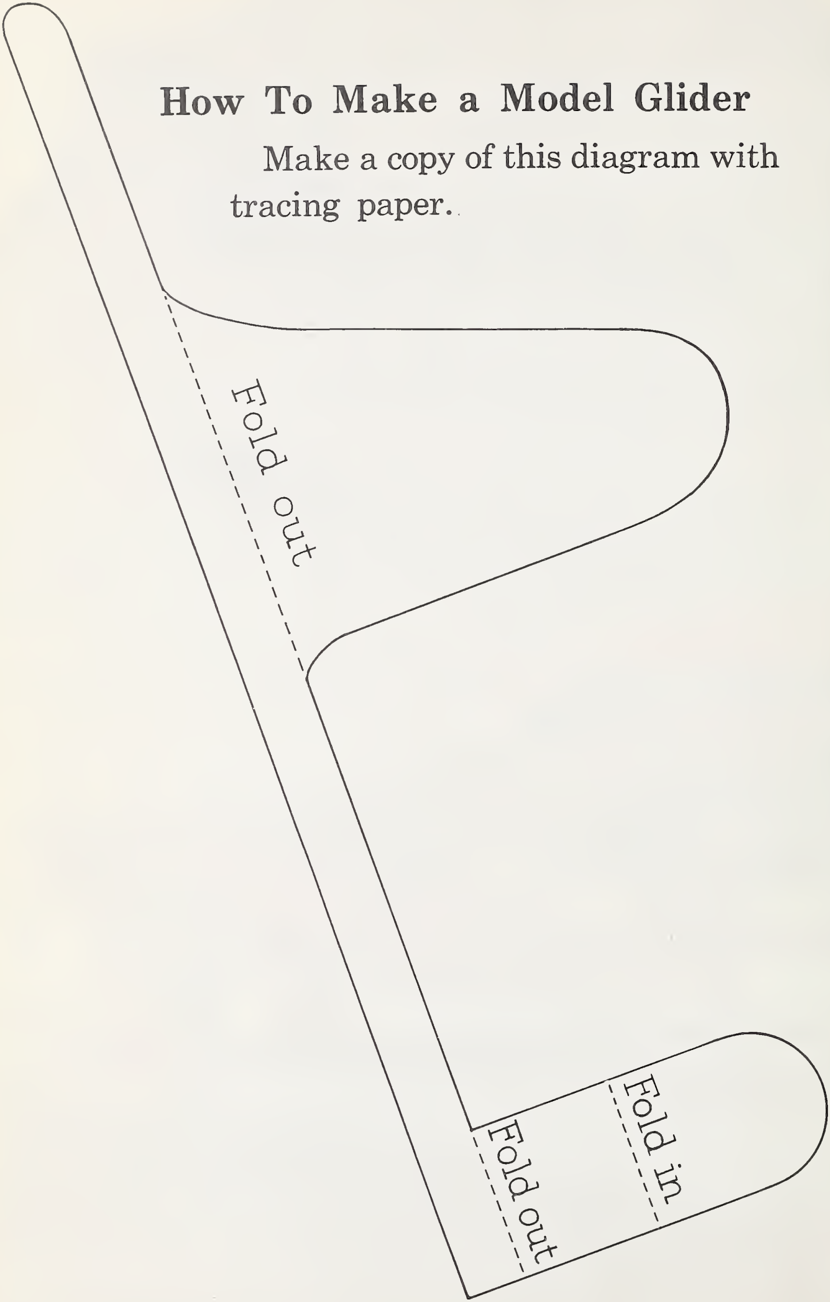
A grasshopper has a hard covering all around its body parts. It has muscles inside the hard covering. The muscles are fastened to the inside of the covering.

1. What do muscles do?
2. Where are the muscles that move your lower arm?
3. What kind of a joint do you have in your elbow?
4. What kind of a joint do you have in your hip?
5. How do you get energy to move your body?
6. What tendons can you find in your leg?
7. What is lean meat?

Airplanes

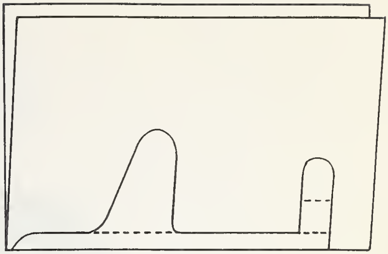
How To Make a Model Glider

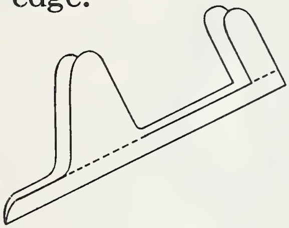
Make a copy of this diagram with tracing paper.



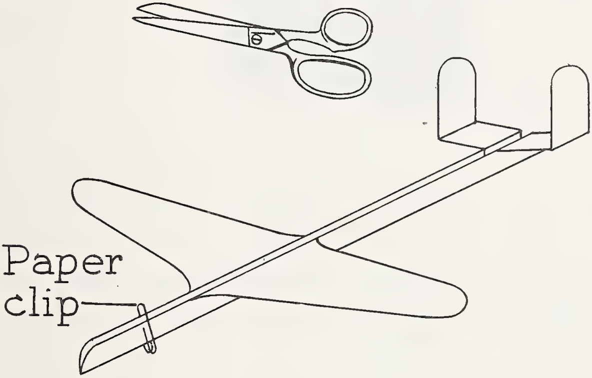
Fold a piece of thin cardboard and trace the diagram on it.

Place the straight line on the folded edge.





Use scissors to cut along the traced line.



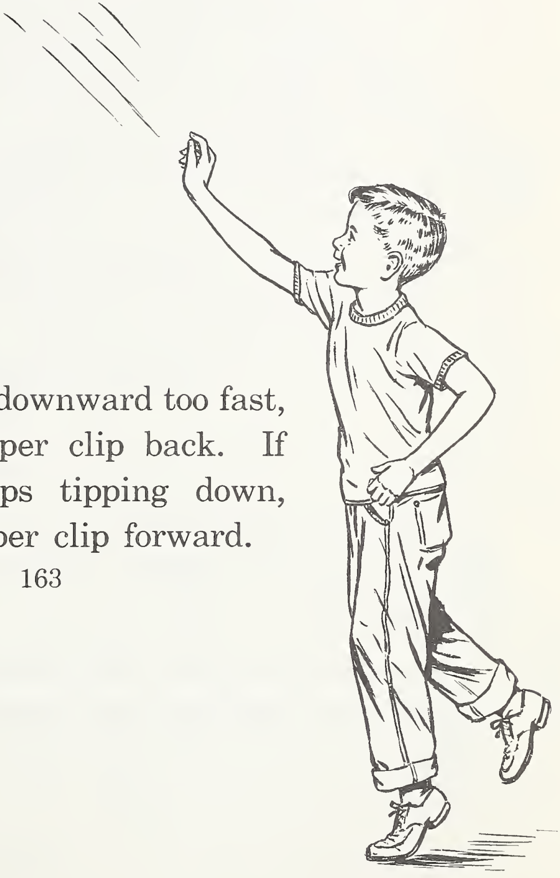
Bend the wings and tail as shown. The finished glider should look like this.

Balancing and Testing

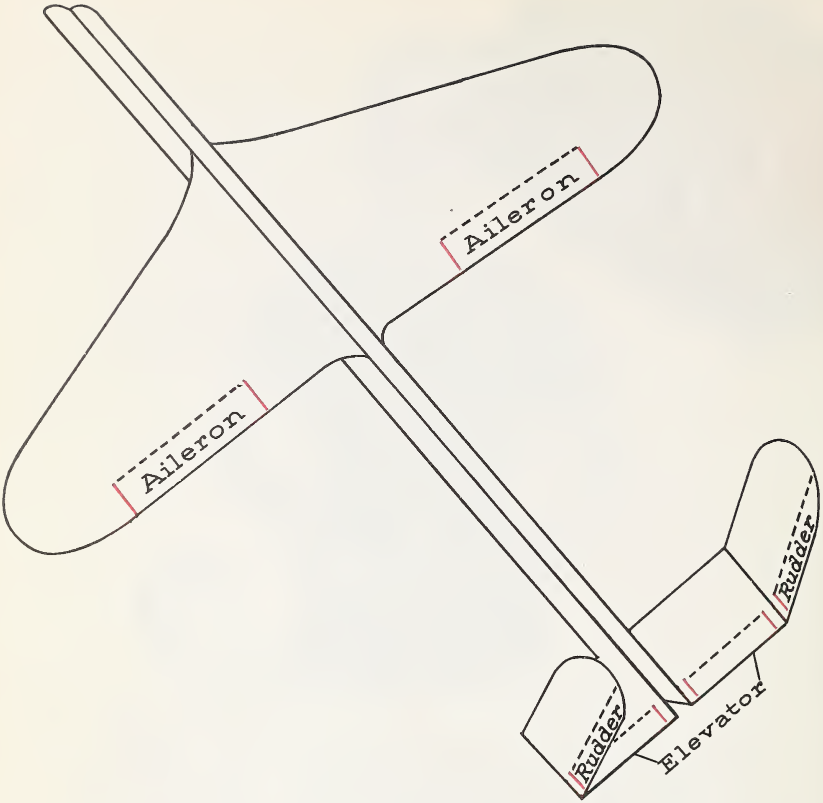
An airplane needs to be well-balanced. If one end is too heavy, it will not fly well.

A glider must be well-balanced too. Rest the ends of the wings on your fingers. If the nose tips down, move the paper clip back. If the tail tips down, move the paper clip forward.

Throw your glider upward. It should glide in a straight line.



If it glides downward too fast, move the paper clip back. If the tail keeps tipping down, move the paper clip forward.



After you have tested your glider, make small cuts at the places marked with red in this picture.

You can now make the glider do different things by bending the controls marked above.

Try each of the following and find out what your glider does:

1. Bend both rudders right.

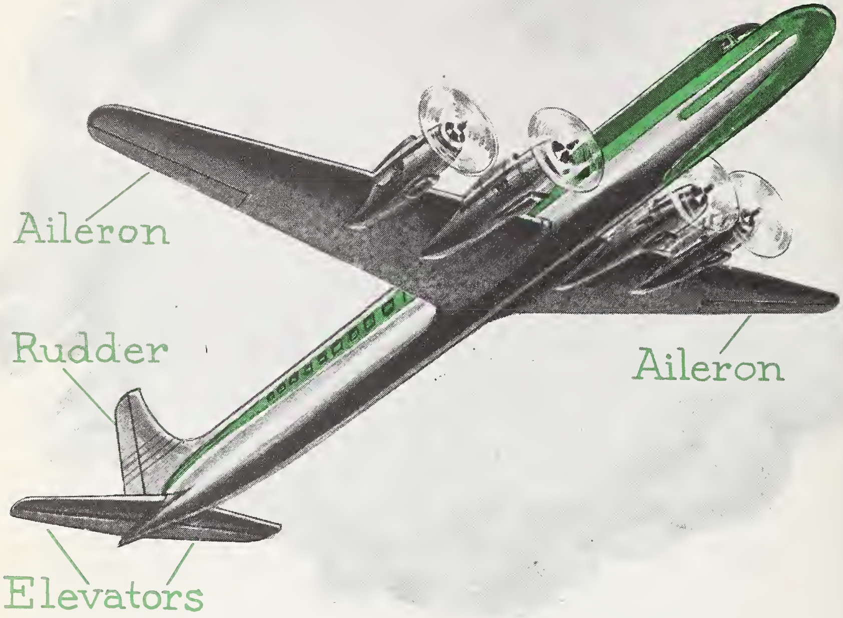
2. Bend both rudders left.

3. Bend both elevators up.

4. Bend both elevators down.

5. Bend the right aileron up and the left aileron down.

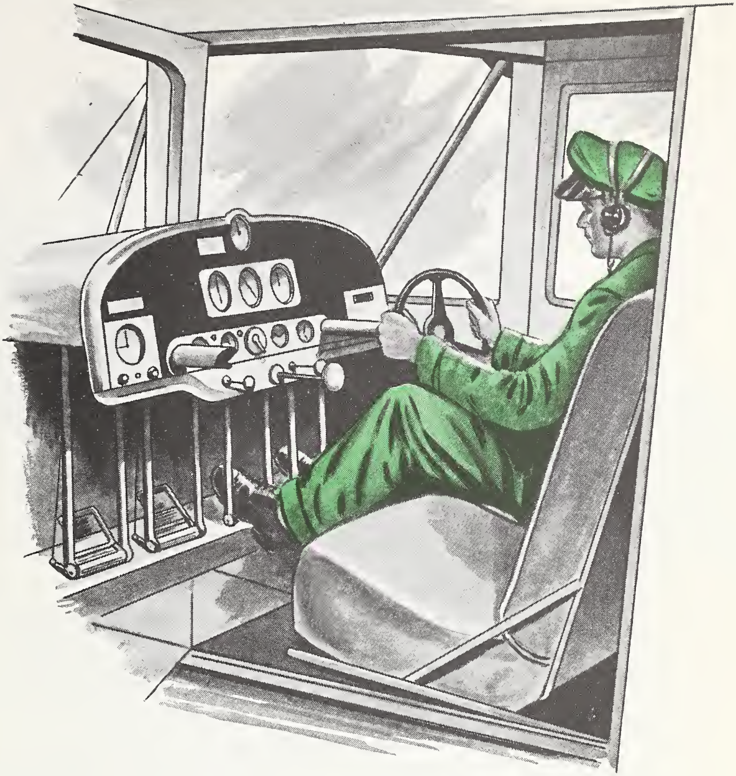
6. Bend the right aileron down and the left aileron up.



How Airplanes Are Controlled

Airplanes have the same controls that your gliders have. The elevators make the airplane head up or down. The rudder steers it. The ailerons tip the wings up or down.

Visit an airport and look for these controls on an airplane.



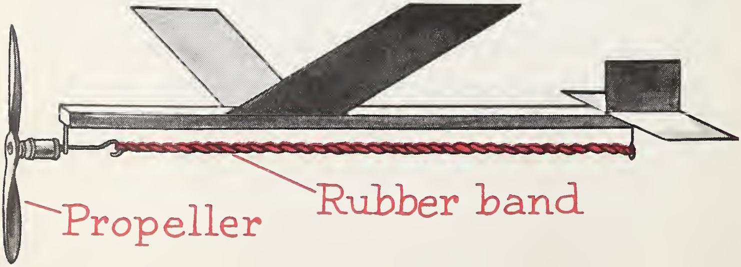
A pilot controls an airplane by using his hands and feet. He steers the airplane with his feet by pushing the rudder pedals.

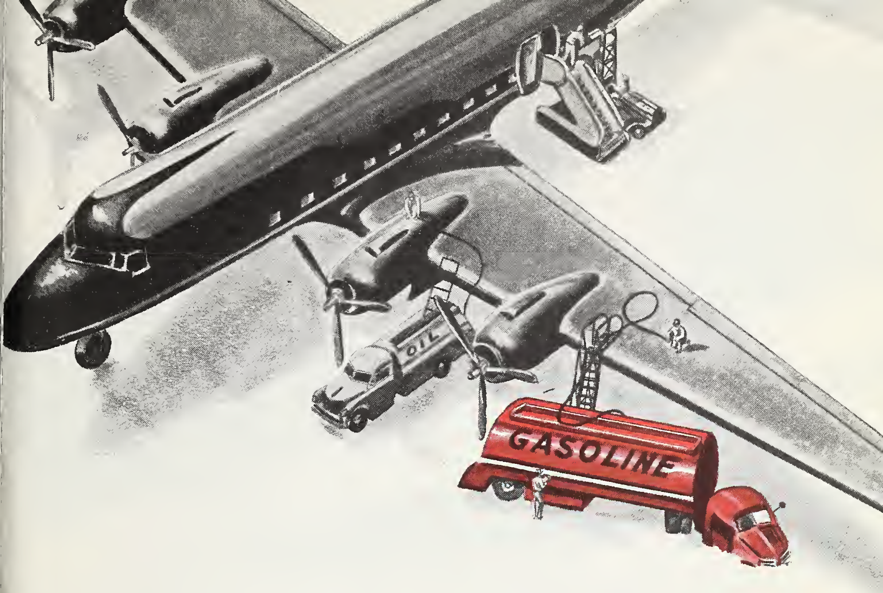
He makes the airplane climb or dive by pulling or pushing the wheel. He makes the airplane bank to one side or the other by turning the wheel.

Energy for Airplanes

Many model airplanes have rubber-band motors. Perhaps someone who makes model airplanes will show you how one flies.

First he turns the propeller backwards to twist the rubber band. This gives the rubber band energy. Then he lets the airplane go. The energy in the rubber band spins the propeller and moves the airplane through the air.

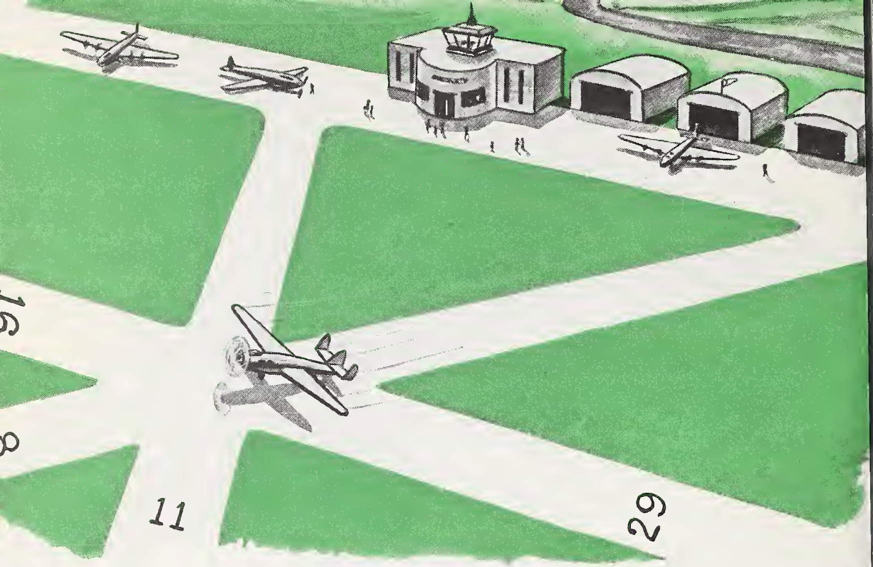




Big airplanes need energy too. They use the energy stored in gasoline.

Most airplanes have gasoline tanks in the wings. You will see men filling the tanks when you visit an airport.

The energy in the gasoline makes the engines turn. They make the propellers spin. The propellers move the airplane through the air.



Wind and Airplanes

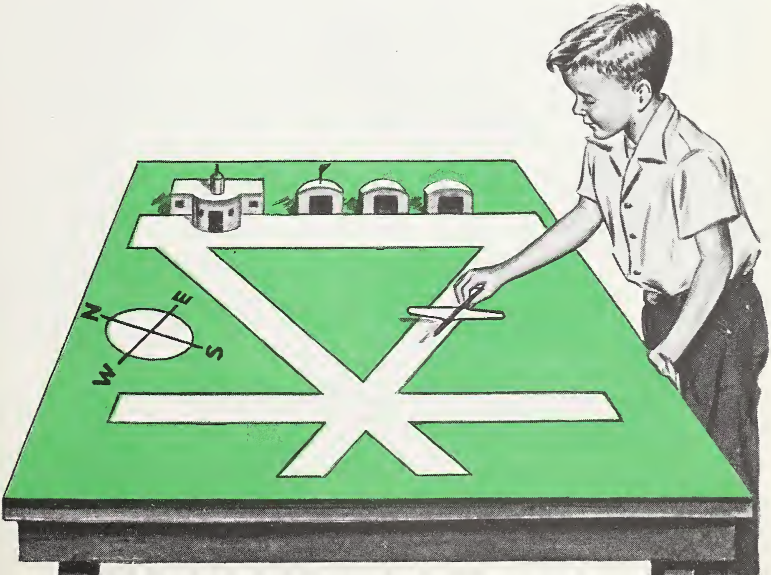
Airports usually have several landing strips that run in different directions. Pilots use one strip when the wind is from the west, and they use a different strip when the wind is from the south.

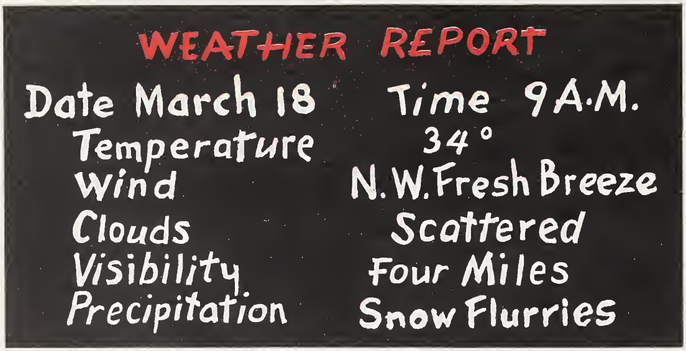
It is easier for planes to land and take off if they head into the wind. If the wind is from the west, the pilot will head his plane toward the west. The pilot will head his plane toward the south when the wind is from the south.

Some fourth-grade pupils visited an airport. Then they made a model airport. Perhaps you would like to make one too.

They used a large sheet of cardboard for the airport. They marked out the landing strips. They used cardboard boxes for the buildings. They used a compass to find directions.

Then they learned to use the landing strips. They chose the strips that let them head into the wind when they landed and took off in their model airplanes.





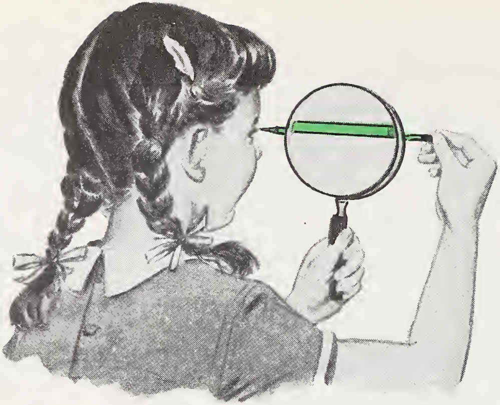
WEATHER REPORT

Date March 18	Time 9 A.M.
Temperature	34°
Wind	N.W. Fresh Breeze
Clouds	Scattered
Visibility	Four Miles
Precipitation	Snow Flurries

The class also kept a record of the weather. Some days were good flying weather. On other days they would not let the planes take off. Can you tell why?

1. How can you tell when a glider is well-balanced?
2. Why are the landing strips at airports usually laid out in different directions?
3. What is the rudder of an airplane used for?
4. How does a pilot make the ailerons move?
5. Why is weather important to a pilot?
6. Where do airplanes get the energy that makes them move?
7. What part of a plane makes it head upward or downward?

A Hand Lens

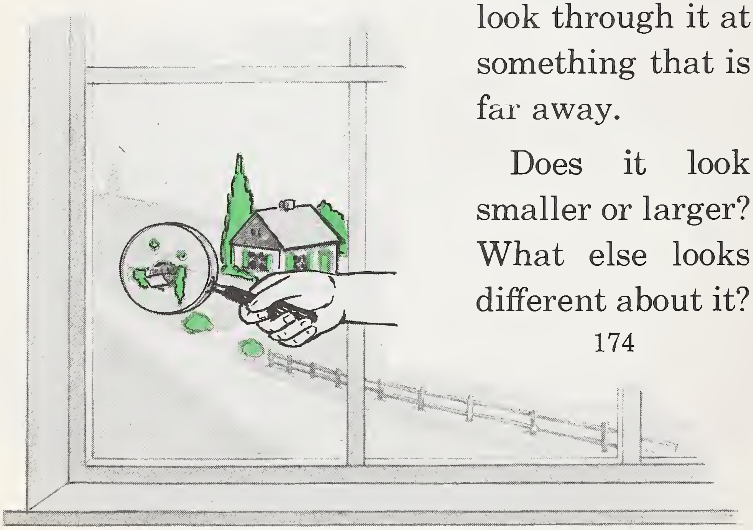


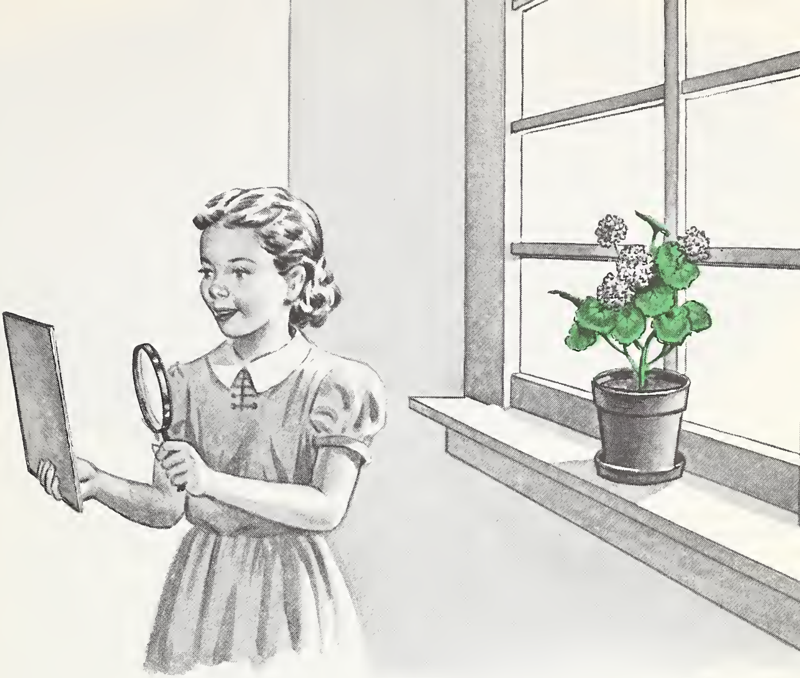
What a Lens Can Do

Look at a pencil through a hand lens. Does the pencil look larger or smaller?

Hold a hand lens as far from your eyes as you can. Then look through it at something that is far away.

Does it look smaller or larger? What else looks different about it?



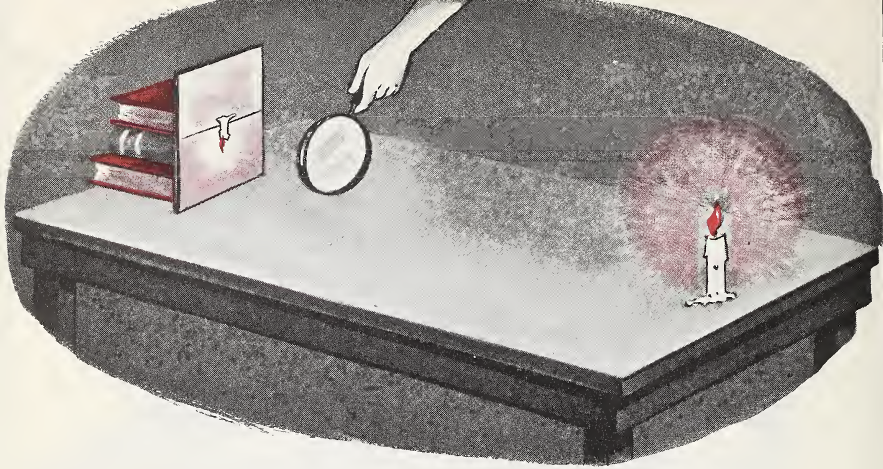


Hold a hand lens between a window and a sheet of white cardboard. Move the lens back and forth until a picture of the window shows on the cardboard.

How does the picture look? Is it in colour? Is it full size? Is it right side up?

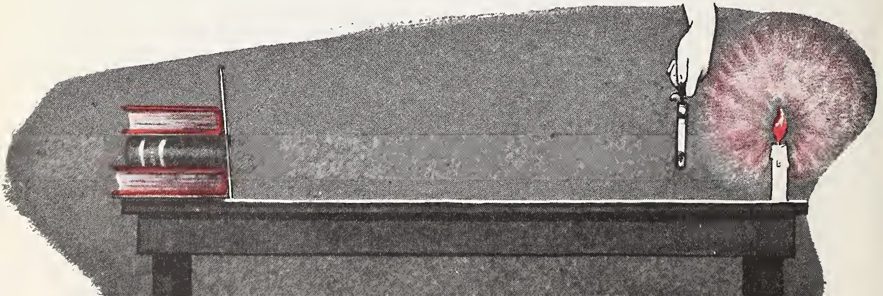
Ask someone to stand before the window and wave his arms.

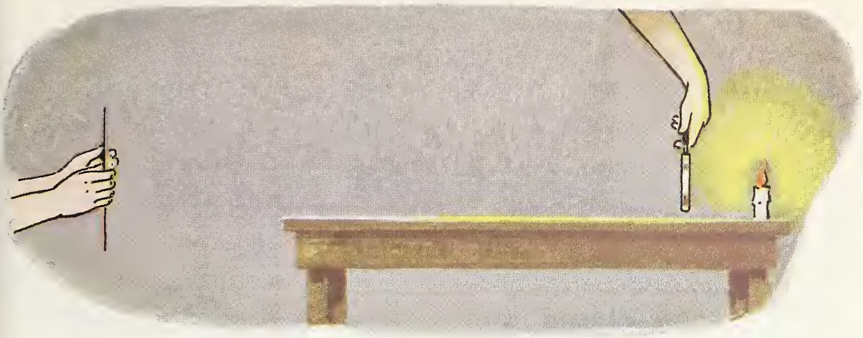
The picture will show better if the shades on the other windows are down.



Make the room as dark as you can for this experiment. Move the lens back and forth in front of the cardboard until a picture of the candle shows on the cardboard. If you cannot make a picture, perhaps the candle is too close to the cardboard.

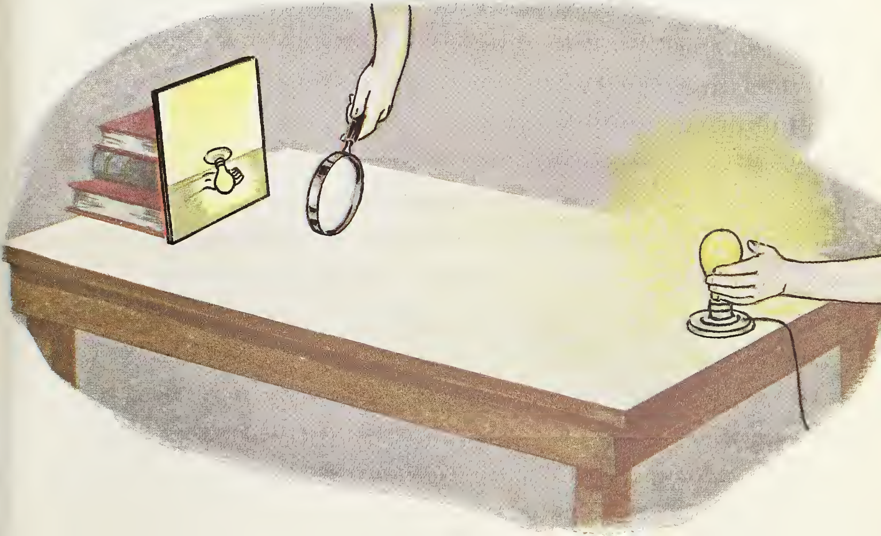
Move the lens back and forth near the candle until a picture shows. Then move the lens back and forth near the cardboard until a picture shows. Which picture is larger?

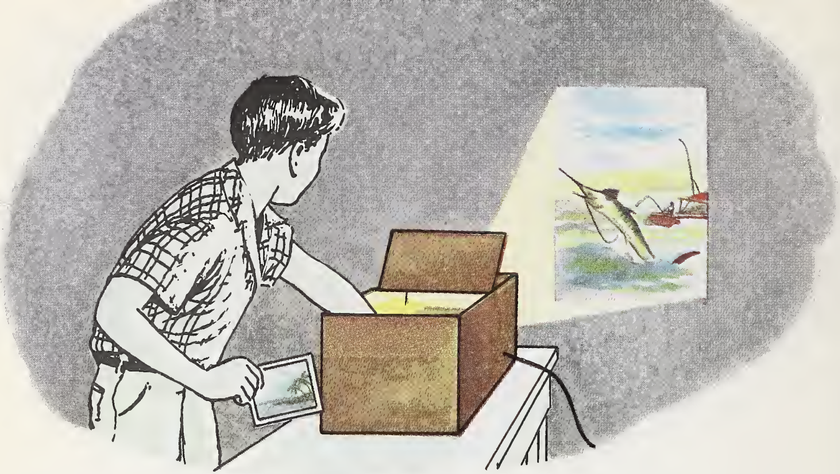




Move the candle and the cardboard farther apart. Move the lens until there is a picture of the candle on the cardboard. What has happened to the picture?

Use an electric lamp in place of the candle. Can you make a picture of the lamp? Put your hand behind the lamp. Can you see a picture of your hand?

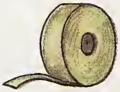




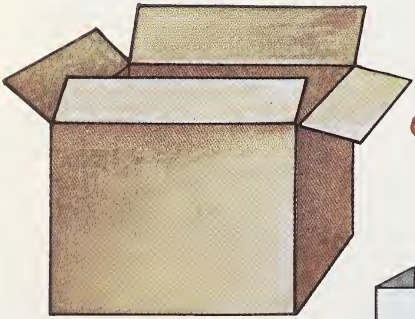
Putting on a Picture Show

Would you like to put on a picture show? You will need a room that can be made dark and the things shown below.

Hand lens



Tape



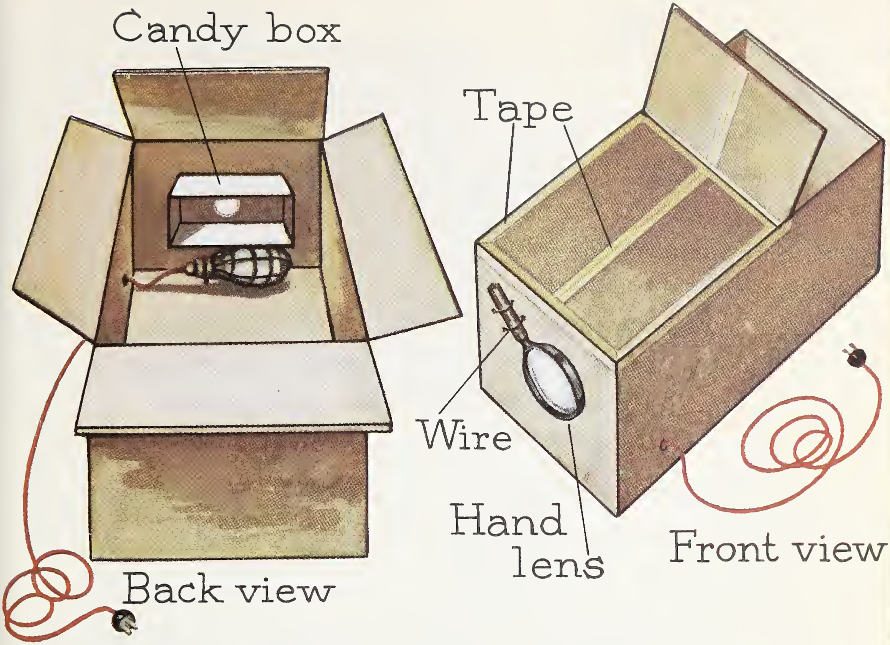
Cardboard carton

Lamp cord

Wire

Candy box

Lamp guard



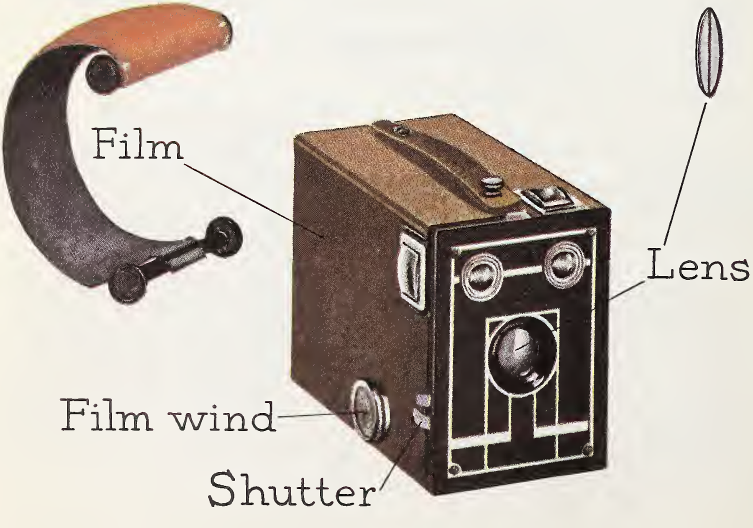
Cut round holes in the carton and in the candy box as shown in the picture. Each hole should be a little smaller than the lens. Fasten the candy box and the lens to the carton with wire.

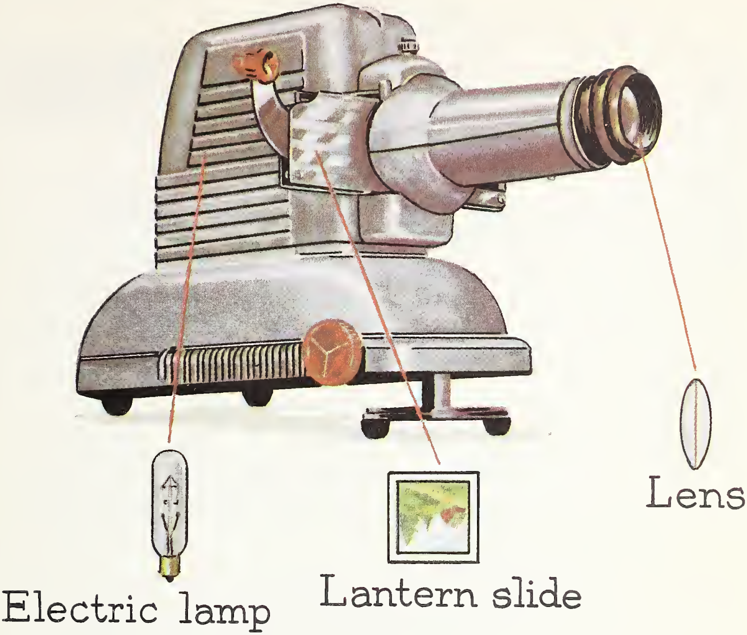
Make a small hole in the carton and put the lamp cord through it. Cut off the cover of the carton and tape it together as shown.

Hold a picture in the back of the box. Move it back and forth until the picture shows on the wall.

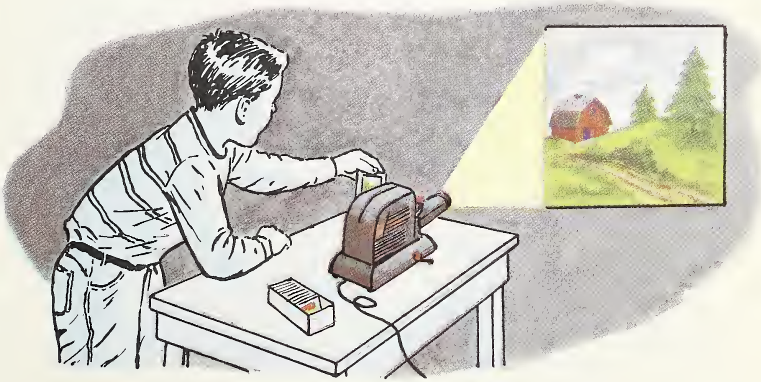
There is a lens in a camera. Light goes through the lens and makes a picture on the film.

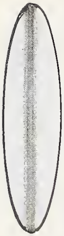
Ask someone to bring a camera to school. Look at the parts.

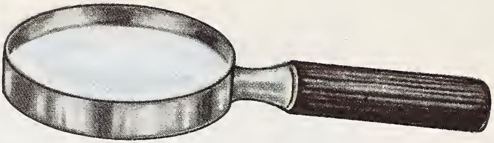




Here is another way that a lens is used to make a picture. Do you know why the lantern slides are put in upside down?



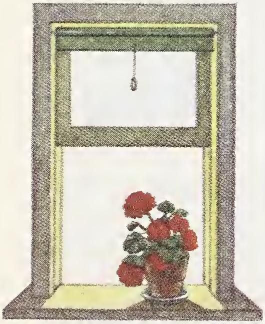




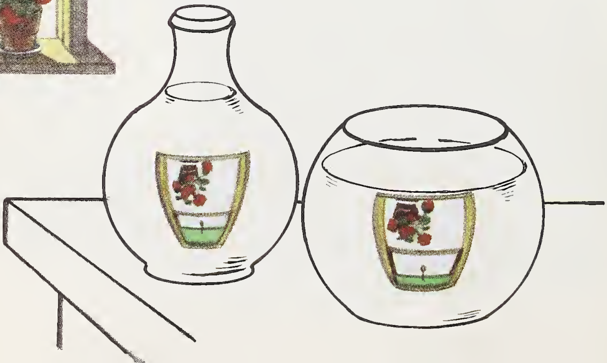
The Shape of a Hand Lens

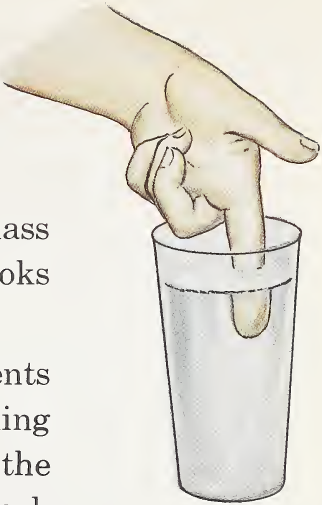
A hand lens is thick in the middle and thin at the edges. Feel the glass with your fingers to find out where it is thick and where it is thin.

Any piece of glass that is thicker in the middle than at the edges will act like a hand lens.



A round glass bowl full of water will act like a hand lens. Can you make a picture on white cardboard with one? Can you make things look larger?

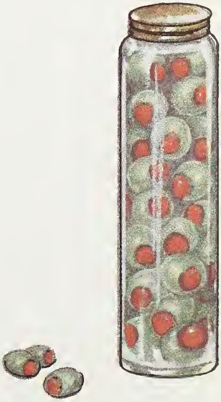


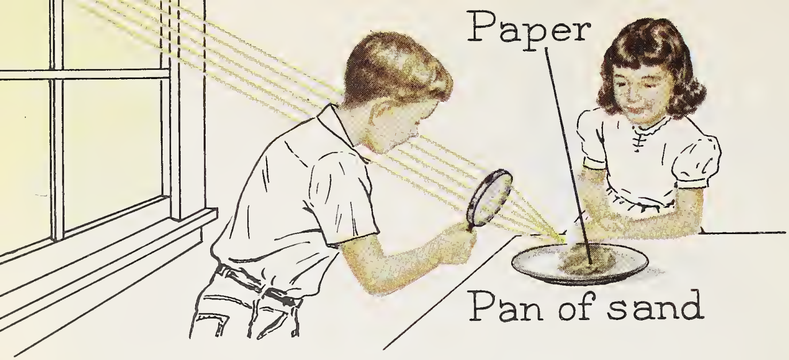


Anything in a round glass jar or bowl of water looks larger than it is.

Make up some experiments with glass bowls and drinking glasses full of water. Do the things inside always look larger?

Does something inside a bowl look larger if there is no water inside?





Fire with a Hand Lens

A hand lens can bend sunlight toward one point. The energy of the sunlight makes this point very hot.

Try to set paper on fire with a large hand lens. Put the paper in a pan of sand. What else should you do so that this experiment will be safe?

---

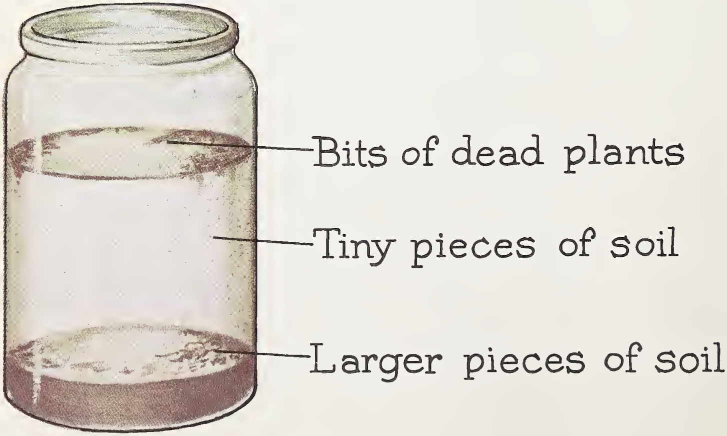
1. What is the shape of a hand lens?
2. What things can a hand lens do?
3. What are some things that have lenses in them?
4. How can you start a fire with a hand lens?
5. How can you make a goldfish look larger?

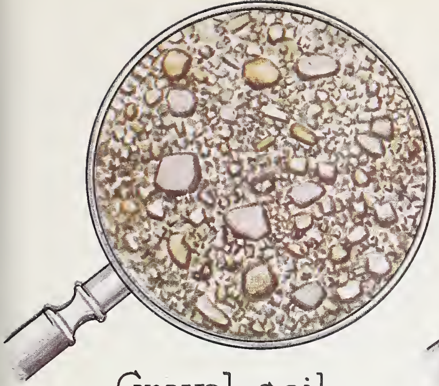
Soil

Kinds of Soil

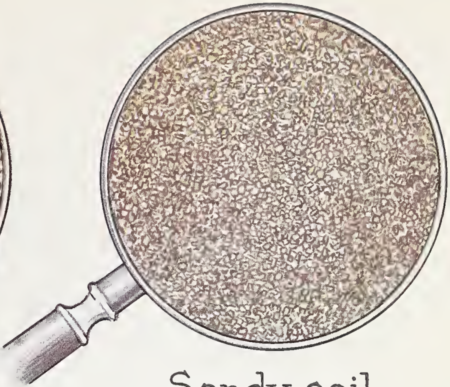
Bring in some garden soil. Stir it in a glass jar of water. Then let it stand.

Are there bits of dead plants in the soil? Are there pebbles and sand? Is there fine soil?





Gravel soil

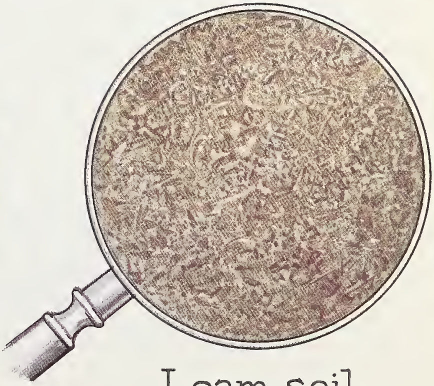


Sandy soil

Soil with pebbles in it is called gravel soil. Sandy soil has much sand in it. Clay soil is very fine. Loam soil has both clay and sand in it. Loam soil often has bits of dead plants in it, too.

Look at different kinds of soil with a hand lens. What kind of soil do you have in your garden? What other kinds of soil can you find?

Clay soil

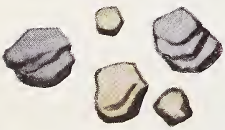


Loam soil

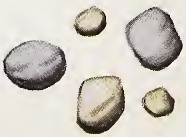
Soil from Rocks

Break a soft rock into small bits. Put the pieces in a bottle that is half full of water. Shake the bottle many times.

Look at the water. What has happened? Take out the pieces of rock. What has happened to them? Can you explain what happened while you were shaking the bottle?



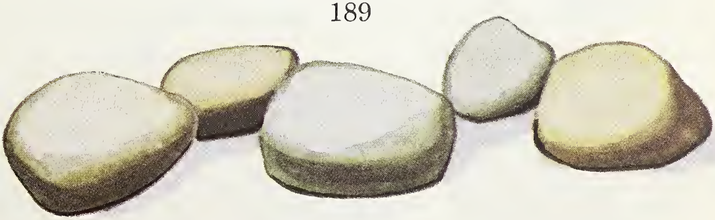
Before shaking



After shaking

The stones in this stream are being rolled and bumped against each other. What happens to the sharp corners of the stones? What happens to the pieces that break off?

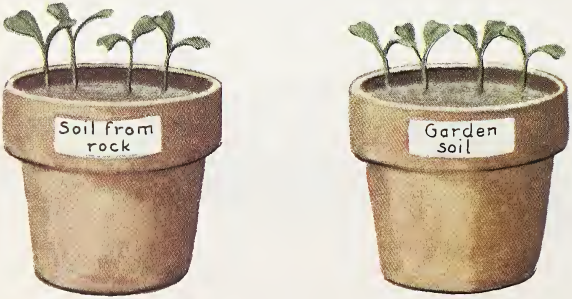
If you live near a stream like this one, bring in some stones that are in the water. Do they look like the stones shown below?



Put pieces of soft rock on a large rock. Cover them with heavy cloth. Pound them with a hammer. They will break into tiny pieces.

Put the soil you have just made into a small flower pot. Put garden soil in another pot.

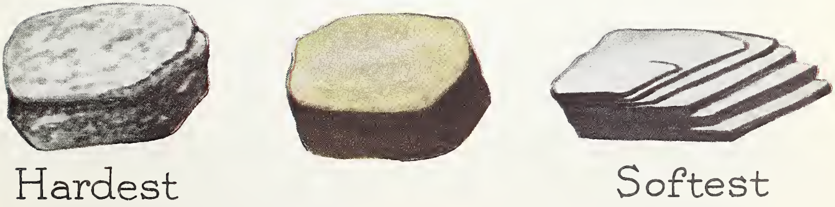
Plant three or four seeds of the same kind in each pot. Keep the soil damp but not wet. Watch the plants for two or three weeks. Which plants grow better?

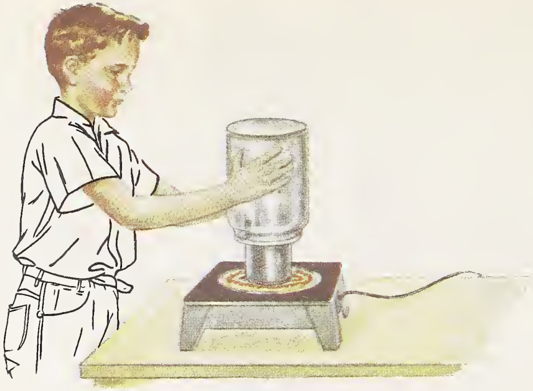


Some rocks are harder and stronger than others.

Bring in small pieces of different kinds of rocks. Try to scratch one rock with another. Which one seems to be the stronger and harder?

Put your rocks in a row with the hardest rocks at one end and the softest rocks at the other end. Which rocks might become soil more quickly than others?

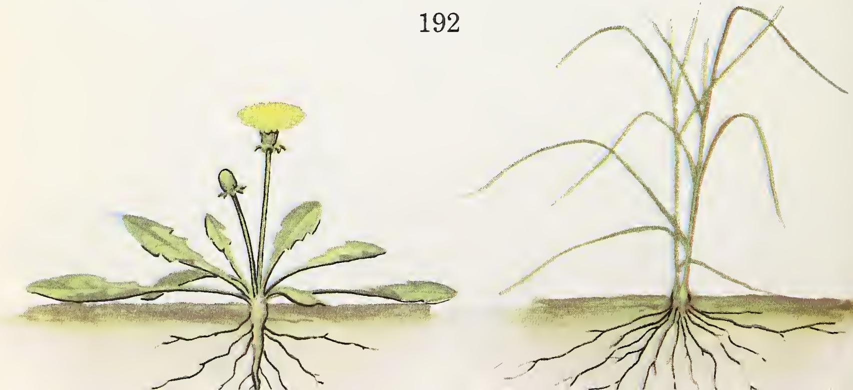




Water in the Soil

Put a handful of soil in a can and heat the can. Hold a glass jar over the soil. What do you see on the glass? If there is water on the glass it must have come from the soil.

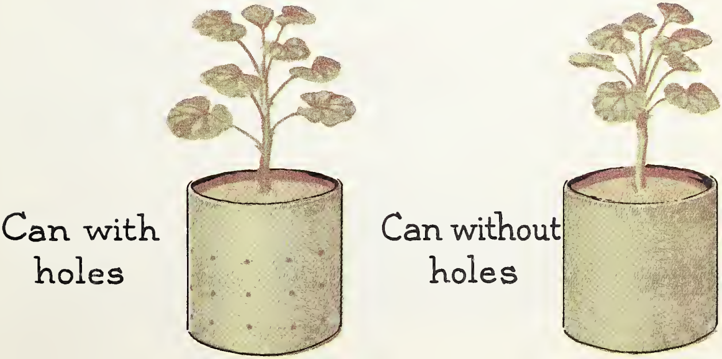
Which part of a plant usually takes in water from the soil? There are different kinds of plant roots. Dig up some and see the differences.



Air in Soil

Put some soil in a glass jar. Pour in some water very carefully. Watch the bubbles of air come from the soil.

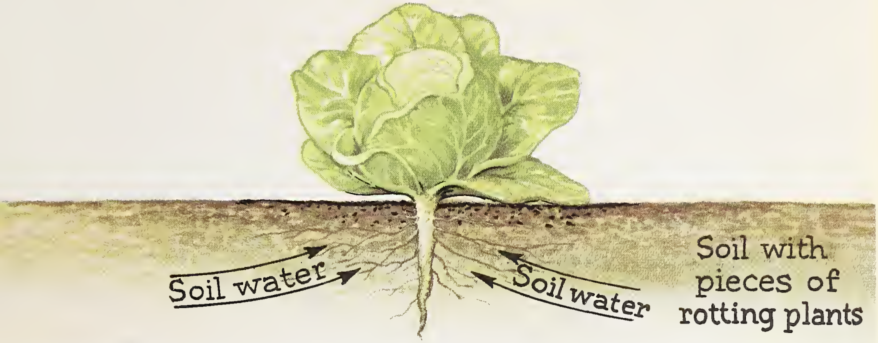
Most plant roots must have air if they are to grow well. Find two small plants of the same kind. Put one in a can that has holes in it. Put the other in a can that does not have any holes. Water both plants well. Which plant grows better? Which plant has more air around its roots?



Dead Plants in the Soil

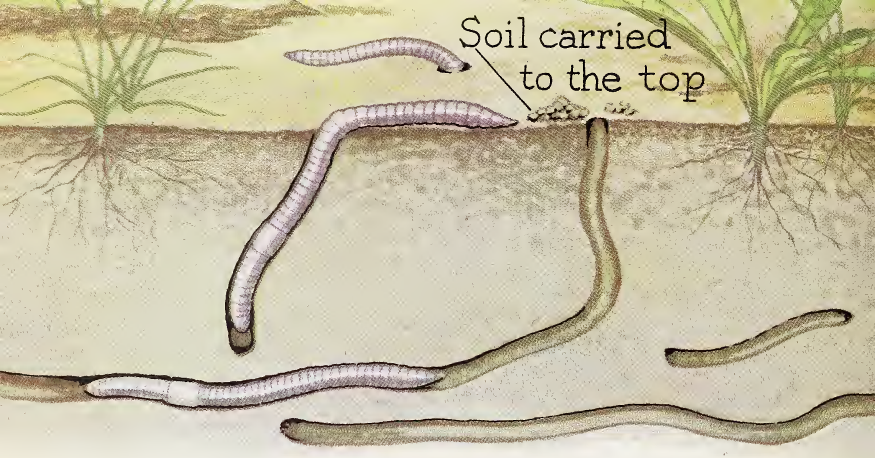
Good soil has bits of dead plants mixed through it. Sometimes there are bits of dead leaves and stems. Sometimes there are bits of dead roots.

Bacteria and other tiny living things rot the dead plants. Mushrooms help rot the dead plants. Rotting changes the dead plants into soil.



Dead plants make good fertilizer. As the plants rot, parts of them dissolve in the water that is in the soil. This water goes into living plants and helps them grow.

Some people burn dead leaves in the fall. Why is it a good idea to let the leaves rot and then put them on gardens?

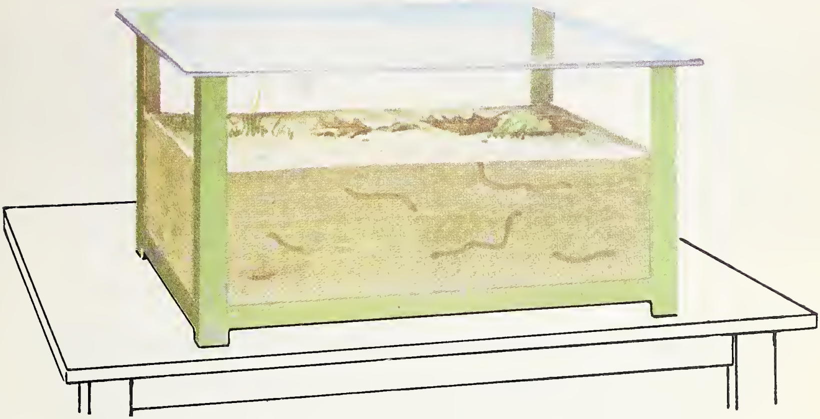

Soil carried to the top

Animals That Live in the Soil

Many animals live in the soil. There are hundreds of earthworms in every garden.

Earthworms make holes in the soil. Water and air go into the holes. Earthworms help keep the soil loose and open.

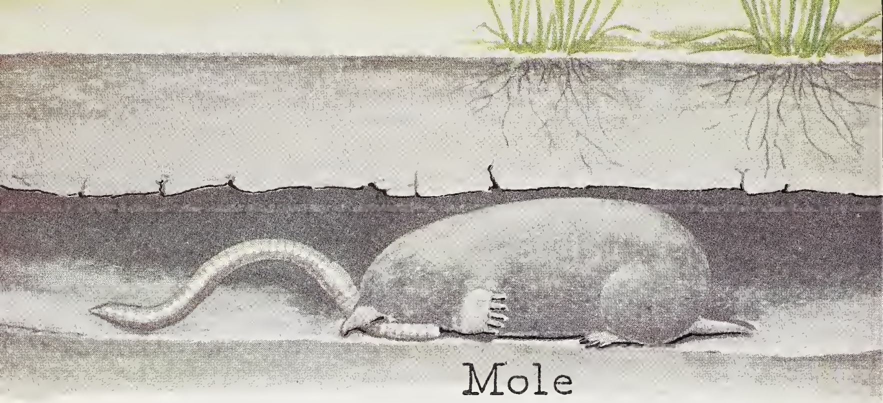
Earthworms also take soil to the top of the ground. They drag leaves into their holes. They mix the soil and bits of dead plants together.



You can keep earthworms alive indoors. Keep them in cool, damp soil. An aquarium with a glass cover makes a good cage to keep them in.

Put a little corn meal in the soil for the earthworms to eat. They will also eat bits of lettuce and cabbage leaves.

Put some dead leaves and grass on top of the soil. The earthworms may take some of them into the soil.

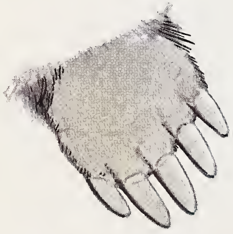


Mole

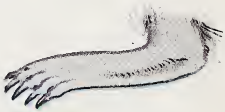
Moles live in the soil. They dig long tunnels as they hunt for earthworms and other small animals.

Moles have short, thick fur that stays clean in the soil. They have very small eyes and cannot see well. The outer parts of their ears are small and do not show. They have long, pointed noses.

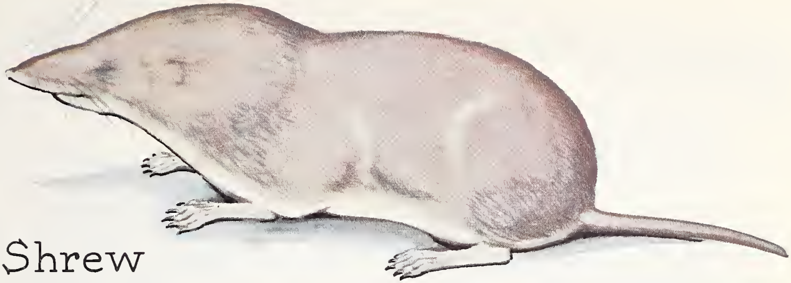
Look at the picture of a mole's front foot. How are such feet helpful to a mole?



Front foot



Hind foot

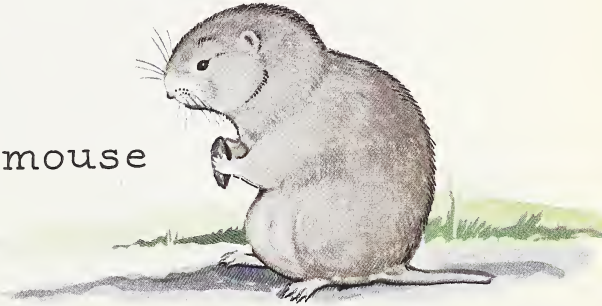

Shrew

Shrews are something like moles. Their eyes are very small. Their outer ears are very small. They have long, pointed noses.

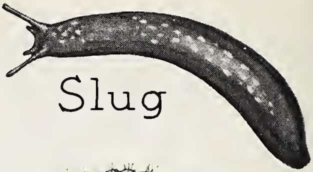
How are the front feet of a shrew different from the front feet of a mole? How are their whiskers different?

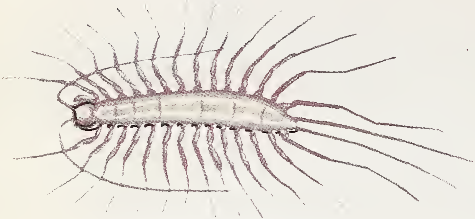
Shrews cannot dig tunnels as well as moles can. They often use the tunnels of moles when they hunt for small animals to eat.

Some people think that moles and shrews are mice. Can you see some ways in which they are different?


Meadow mouse

Millipede


Slug


Centipede

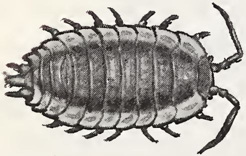
May beetle grub

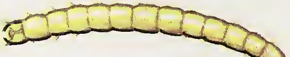
Dig up some garden soil and put it in a pan. What kinds of animals do you find?

Dig up some soil in a woods and other places to see what animals you can find.

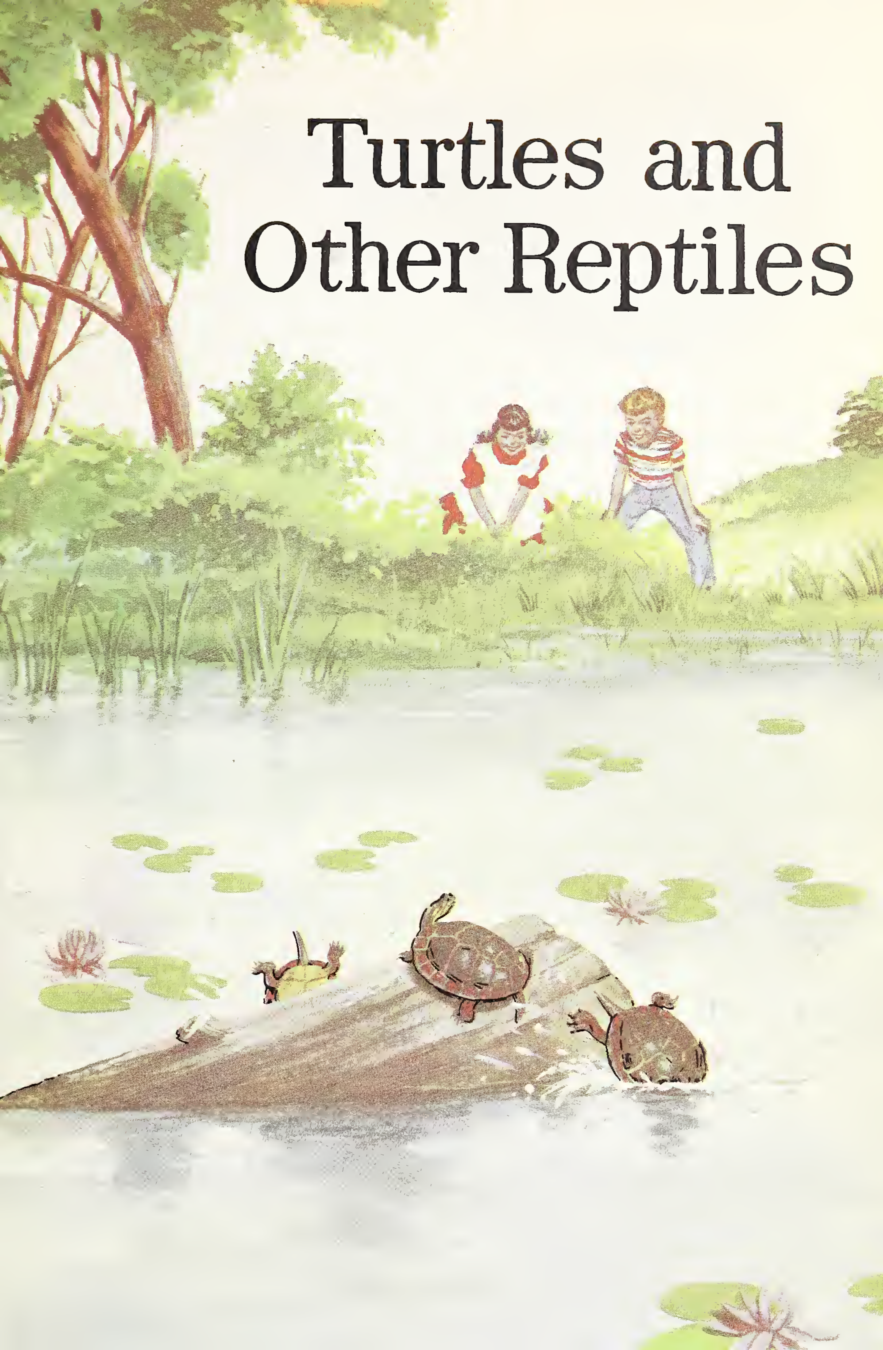
---

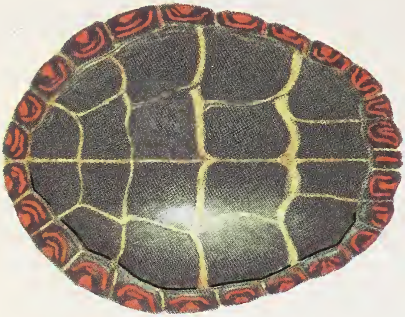
1. Why is soil so important to us?
2. What is soil made from?
3. How do dead things become part of the soil?
4. Name some animals that live in soil.
5. Name some different kinds of soil.
6. Why are dead plants good for the soil?


Sow bug


Wireworm

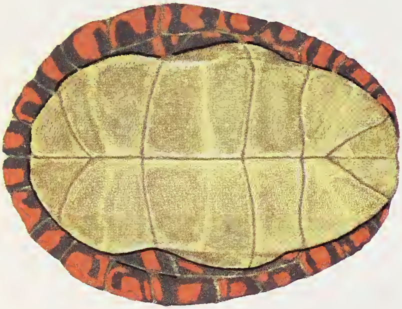
Turtles and Other Reptiles



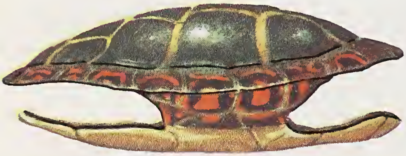


The Turtle's Shell

The turtle's shell is in two parts. There is an upper part and a lower part.



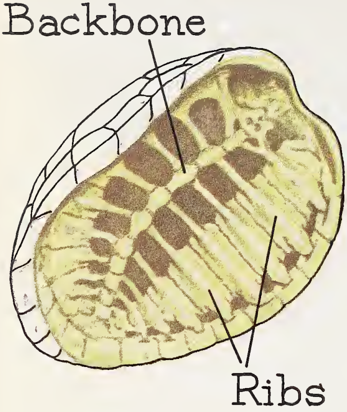
The two parts of the shell are fastened together at the sides.



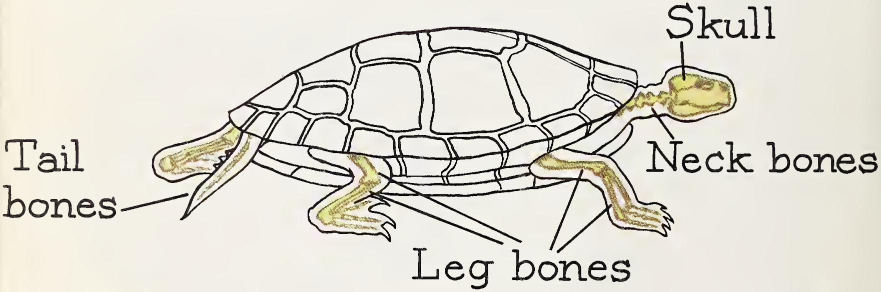
The turtle's head, legs, and tail come out from between the upper and lower parts of the shell.

A frightened turtle will try to dive into the water if it can. If it cannot, it pulls its head, legs, and tail into the shell as far as they can go.

A Turtle's Skeleton



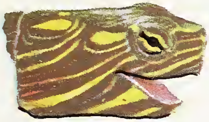
A turtle has bones. The shell is fastened to the ribs and the backbone. Perhaps you can find a turtle's shell for study.



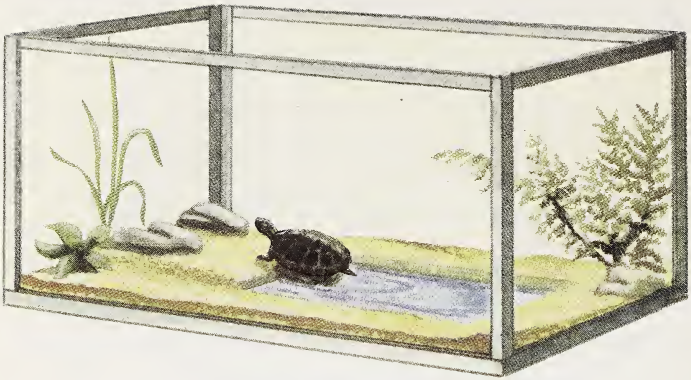
Most turtles have webbed feet. How does this help them? Can you name other animals that have webbed feet?

How Turtles Eat

A turtle has no teeth. It has strong, sharp jaws. It can catch animals and bite off pieces of them with these jaws.



Turtles eat insects, snails, small fish, and tadpoles. They eat dead animals, too. Some kinds of turtles also eat plants.



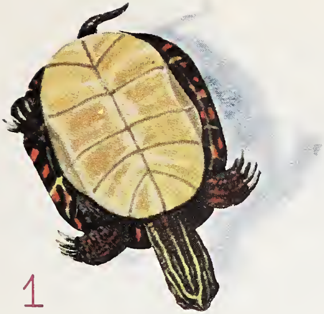
Keeping a Turtle

A turtle makes an interesting pet. Get a small turtle and keep it in a large aquarium.

Nearly all turtles need some water. Some kinds eat in water. These turtles cannot eat in air.

Put a pan in the aquarium and put sand or soil around it. Put a stone in the pan so the turtle can climb out.

Feed the turtle live earthworms and insects. The turtle may also learn to eat tiny pieces of meat.



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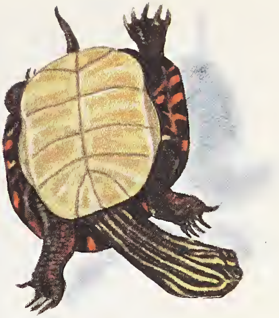

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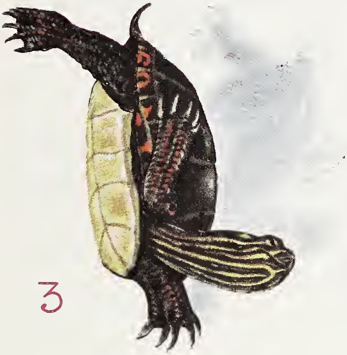

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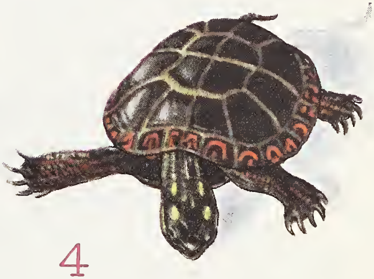


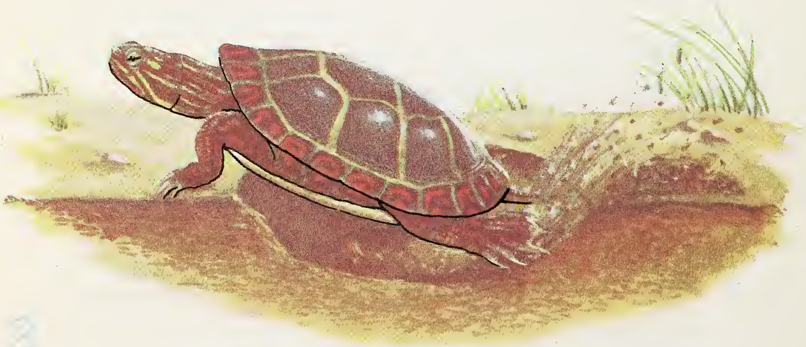
4

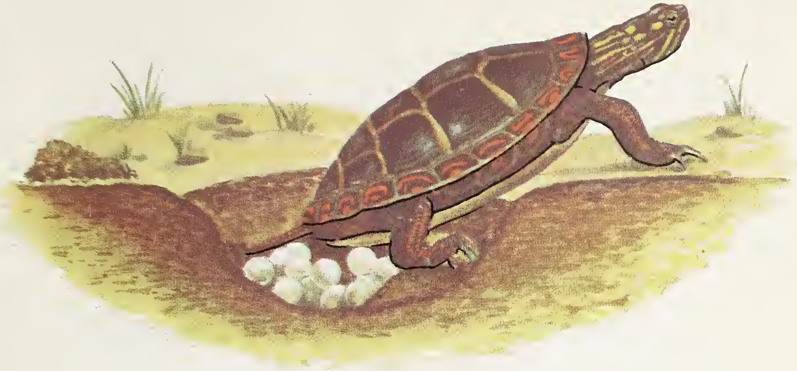
How a Turtle Turns Over

A turtle can turn itself over if it is on its back. Can you find out how a turtle turns itself over? Does it use its legs? Does it use its tail? Does it use its head?

Turtle Eggs

In late spring the female turtle looks for a sunny bank of loose soil. She digs a hole with her hind feet.





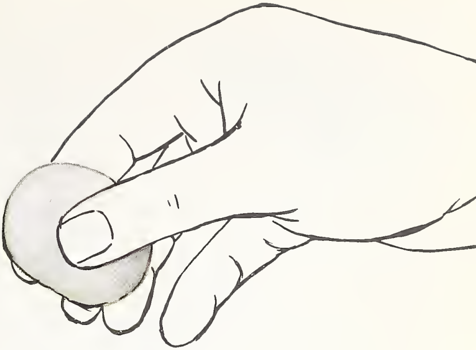
3

The female turtle lays her eggs in the hole. Then she covers them with the soil she dug from the hole.

The female turtle leaves the sunny bank and goes back to the water. She does not look at the eggs again.

4

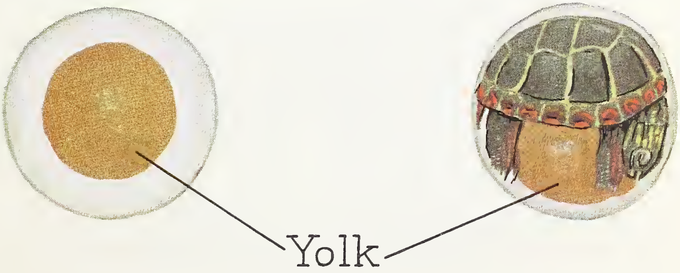
Here are two animals that eat turtles' eggs. No matter how well the eggs are buried, these animals find some of them.

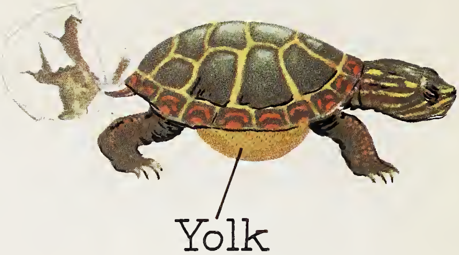


The shell of a turtle's egg is not hard like the shell of a bird's egg. The shell is more like thin leather.

Sunshine warms the soil and keeps the eggs warm. A little spot in each egg begins to grow.

There is a yolk in each egg. The yolk holds food for the growing turtle.





Young Turtles

In three or four weeks a little turtle is ready to leave the egg. It tears a hole in the shell and comes out.

The little turtle is weak. It is not ready to walk or swim. It stays in the soil until it is stronger.

The little turtle still has the yolk on it when it hatches. The turtle uses the food in the yolk while it stays in the soil.

The little turtles dig from the ground when they are strong enough. Then they go to the water.

Many animals eat the little turtles as they go to the water. Foxes, skunks, raccoons, crows, gulls, and hawks find them good food.

As the turtles grow, their shells become harder. Then not many animals can eat them.

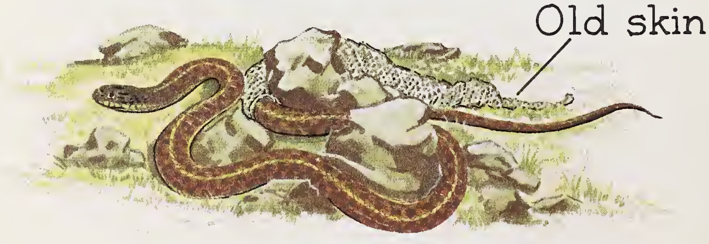
Garter snake

Snakes

Although they do not look much alike, snakes and turtles are both called **reptiles.** In what ways are they different?

A snake is covered with scales but it is not like a fish. Its skin is dry. The skin of a fish is wet and slippery.

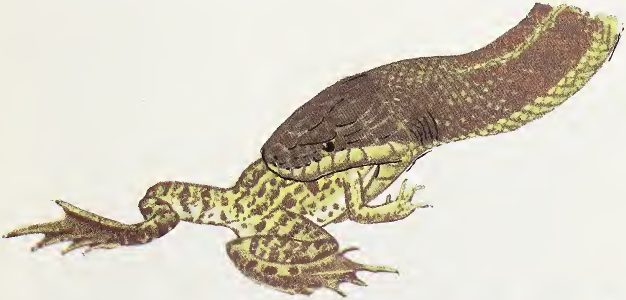
A snake sheds its outer skin in one piece. Sometimes you can find a snake skin in a field where snakes live.

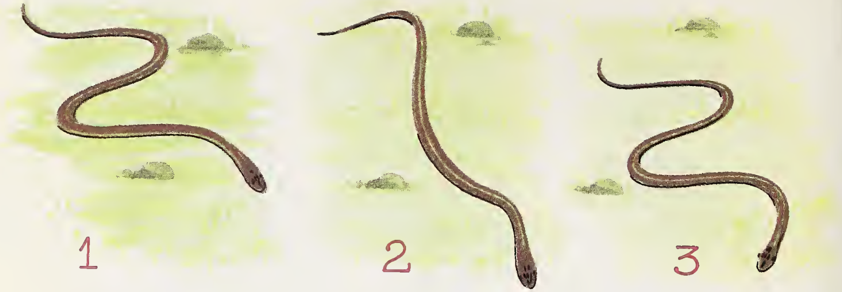


How a Snake Eats

A snake has a long tongue. The snake pushes its tongue out every now and then. Some people believe that the snake smells and tests the air with its tongue. Perhaps it also feels with its tongue.

A snake swallows its food without chewing it. The snake can swallow animals bigger than itself because its jaws can be opened very widely.



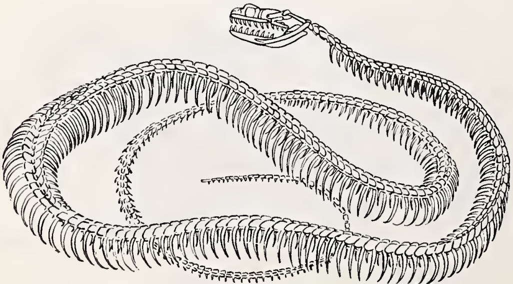


How a Snake Moves

People often wonder how a snake can move over the ground without legs.

First the snake makes a curve in the back part of its body. This curve catches on rough places on the ground, and the snake can then push the front part of its body forward.

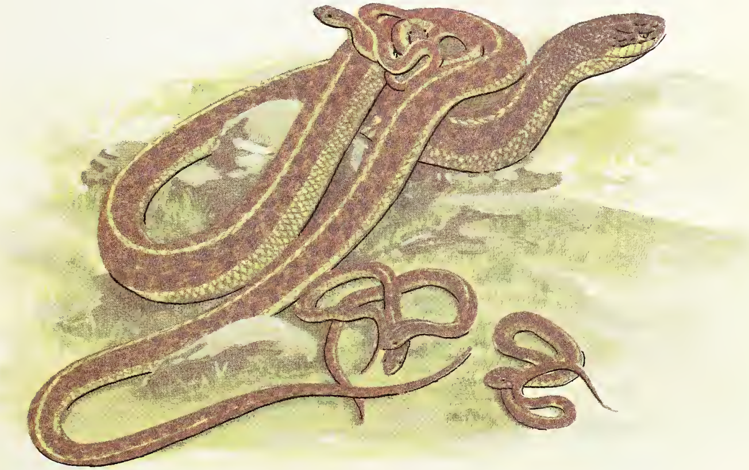
The snake next makes a curve in the front part of its body. It can now pull up the back part of its body. The snake does this over and over. Watch one move.

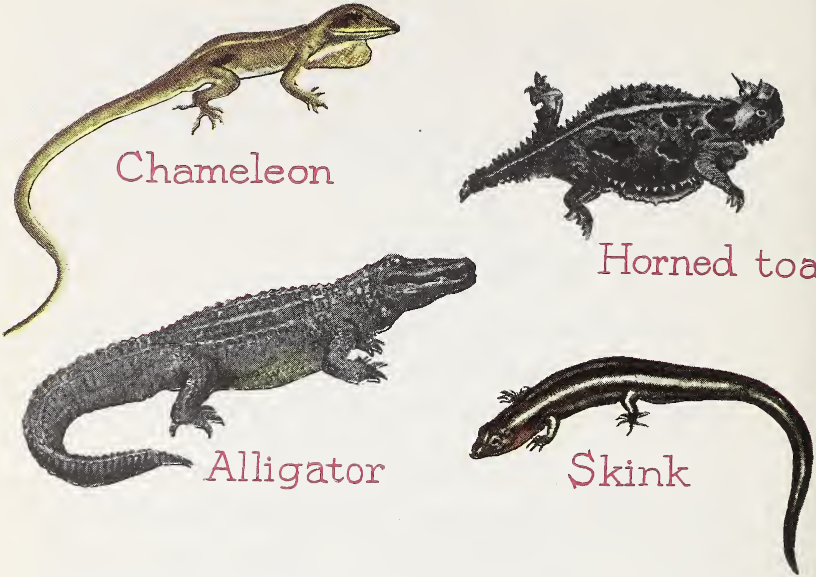


Young Snakes

Some snakes lay eggs. The females bury the eggs and leave them. They do not take care of them.

The females of other kinds of snakes keep the eggs inside their bodies until the eggs become little snakes. Then the young snakes are born alive.





Other Reptiles

Here are four other reptiles. Have you ever seen any of them? What kinds of reptiles live near your home?

---

1. What do turtles do when they are frightened?
2. What do turtles eat?
3. Where do turtles lay eggs?
4. What animals eat turtles' eggs?
5. Do snakes have bones?
6. How does a snake move?

The Major Topics Presented in Each Unit

Unit 1 — Night Comes. What happens when night comes. How we get light for night time. What causes day and night.

* **Unit 2 — Insects That Carry Disease.** How houseflies and mosquitoes live. How houseflies and mosquitoes carry disease. How we can protect ourselves from houseflies and mosquitoes.

Unit 3 — Growing Plants Indoors. Some plants we can have in our homes in winter. How we can start plants without seeds. What plants need to grow well.

Unit 4 — Things That Dissolve. Some things that dissolve in water. How we use things that are dissolved in water. How dissolved things are taken from the water.

* **Unit 5 — Stopping Safely.** Why moving things cannot stop at once. Why we should know about stopping distances. Some ways to be safe on streets and highways.

Unit 6 — Birds in Winter. Some birds that spend the winter with us. Where birds get food in winter. How birds stay warm in winter.

Unit 7 — Water in Plants. How plants are different in their need for water. Where water moves in plants. Some things dissolved in the water of plants.

* **Unit 8 — Static Electricity.** How objects can be given an electric charge. What lightning is and what it does. The two kinds of charges and what they do.

Unit 9 — Balancing Forces. How things can be made to balance. How we weigh things. How we use levers.

* **Unit 10 — How We Move.** What muscles are and what they do. How forces act inside our bodies. How we get energy to move our bodies.

Unit 11 — Airplanes. How airplanes are controlled. How airplanes get energy to move. How weather affects flying.

Unit 12 — A Hand Lens. What a magnifying lens can do. How we use magnifying lenses.

Unit 13 — Soil. What is in soil. How soil is made. Why soil is important to living things.

Unit 14 — Turtles and Other Reptiles. What snakes and turtles are like. How turtles and snakes live.

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* These units include health and safety material.

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